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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

Institute of British Foundrymen.

PRESIDENT, 1926-27: Vincent C. Faulkner, "Thalassa," Carlton Avenue, Kenton, Middlesex.

LIST OF SECRETARIES—

General Secretary: T. Makemson, Saint John Street Chambers, Deansgate, Manchester. London Office, 49, Wellington Street, London, W.C.2.
Birmingham: F. K. Neath, 16, Sarehole Road, Hall Green, Birmingham.
Sheffield: R. Village, "Bircholme," Dronfield, near Sheffield.
Scottish: J. Bell, 60, St. Enoch Square, Glasgow.
Lancashire: H. Stead, 1st/36, Cheetham Hill Road, Stalybridge, Cheshire.
London: H. G. Sommerfield, Charterhouse Chambers, Charterhouse Square, London, E.C.1.
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Wales and Monmouth Branch: J. J. McClelland, M.I.Mech.E., Druslyn, Bishops Road, Whitechurch, Glam.
Middlesbrough: N. D. Ridsdale, 3, Wilson Street, Middlesbrough.

Welsh Engineers' and Founders' Association

Secretary: P. J. Griffiths, 20, Fisher Street, Swansea.

Foundry Trades Equipment & Supplies Association.

Secretary: K. S. Bridges, Avenue Chambers, Southampton Row, London, W.C.1.

The Sheffield Convention.

The Council of the Institute of British Foundrymen, when it accepted the invitation of its local branch to hold this year's annual convention at Sheffield, was well aware that there are but few centres more advantageously placed for such purposes. It is the centre of the steel castings industry, possesses in the neighbourhood some of the most important iron foundries in Great Britain, whilst in Rotherham there is a considerable trade in brass castings. Its University possesses a metallurgical department presided over by Dr. Desch, which is admired and appreciated throughout the whole world. It was within its walls that the major portion of the micro-constituents of cast-iron were discovered and developed.

Whilst the manufacture of steel castings is one of the principal products of the Sheffield works, it does not rank as its first industry. Before the war armaments were the most important production, followed by heavy steel of the better sort, such as rails, tyres and axles. Then came tool steel of every type, whilst in addition the silver plate, cutlery and edge tools occupied prominent positions. Most of these industries demand skilled metallurgical direction, with the result that there are at least 100 chemical laboratories controlling the city's output. Little wonder, then, that Sheffield is recognised as the centre of the world's metallurgical thought.

Critical though Sheffield is, we believe that they will welcome the technical papers to be presented at the forthcoming conference as important contributions to metallurgical progress. Ten are to be presented, and the important subject of high-duty cast-irons is to receive special attention. Professor Piwowarsky's contribution will be of special interest, as it is the first time that a German national has contributed an official exchange paper. The number of papers of foreign origin has risen to five: America contributes two; and France, Belgium and Germany, one each. The British papers are of a high order and in every way equal to those of other years.

There is but one thing needed to make this in every way an outstanding success, and that is a record attendance. We cannot urge too strongly upon foundry proprietors and directorates that they cannot make a better investment than ensure either personal or other adequate representation. On these occasions one meets the leaders of thought in the industry, and each participant, either by his informal conversation or preferably by his contributions to the discussions, helps to model "public opinion" relative to his industry. The larger works are making such rapid advances that some of the smaller ones imagine that the only way they can make progress is by economising on metallurgical work—the very phase of activity which keeps the larger ones to the forefront. If the smaller foundry-owner would but take a more prominent part in the co-operative organisations he would soon find that scientific work did not merely pay for itself, but also created a reserve for the prosecution of domestic research and some contribution towards national efforts. If they will but make a start with the Sheffield meeting, it is reasonably sure that they will never be satisfied until they are running their foundries on a scientific and progressive basis.

Institute of British Foundrymen.

SHEFFIELD CONFERENCE.

The Annual Convention of the Institute of British Foundrymen is to be held at Sheffield on July 5, 6, 7 and 8.

The railway companies have agreed to issue tickets at the ordinary single fare and one-third for the double journey, fractions of 3d. reckoned as 3d., upon surrender, at the time of booking, of vouchers obtainable from the General Secretary. The tickets will be available from July 4 to 9. Numbers are limited at all the works who have invited delegates. Early application is necessary. Tickets are not transferable.

PROGRAMME.

Tuesday, July 5.

6.0 p.m.—General Council meeting in the Cutlers' Hall, Church Street, Sheffield.

8.0 p.m.—A cordial invitation is extended by the Master and Mistress Cutler (Mr. and Mrs. David Flather) to all members, delegates, and ladies to a reception at the Cutlers' Hall. Refreshments. Dancing 9 to 11. (Evening dress optional.)

Wednesday, July 6.

9.30 a.m.—Conference commences at the Applied Science Department of the University of Sheffield, St. George's Square. Welcome by the Vice-Chancellor of the University (Sir Henry Hadow, C.B.E., M.A., D.Mus., LL.D., J.P.), the Lord Mayor (Alderman J. G. Graves, J.P.), the Master Cutler (Mr. David Flather), the President of the Sheffield Chamber of Commerce (Mr. J. H. Chapman).

1.0 p.m.—Lunch at the University, Western Bank. Tickets 3s. each (members, delegates and ladies).

2.0 p.m.—The Convention Committee invite all ladies to join a motor-coach trip to Baslow to visit Chatsworth House. Tea will be provided at the Grand Hotel, Baslow.

2.15 p.m.—Visits to the works of Messrs. Edgar Allen & Company, Limited, Cammell, Laird & Company, Limited, Newton, Chambers & Company, Limited, and Vickers, Limited.

7.15 p.m.—Dinner at the Royal Victoria Hotel, for members, delegates and ladies. (Evening dress optional.) Tickets 10s. each. Member and lady 17s. 6d. Dancing 10.30 to 12 p.m., providing sufficient applications are received.

Thursday, July 7.

9.30 a.m.—Conference resumes at The University, St. George's Square.

1.0 p.m.—Adjourn for lunch at the University, Western Bank, 1.15 p.m. (members, delegates and ladies). Tickets 3s. each.

2.30 to 4.0 p.m.—Conference continues.

4.30 to 5.30 p.m.—Civic Reception at the Town Hall by the Lord Mayor and Lady Mayoress (Alderman and Mrs. J. G. Graves). Afternoon tea (members, delegates and ladies).

8.30 p.m.—All members, delegates and ladies are invited to the Hippodrome by the Convention Committee.

Friday, July 8.

9.30 a.m.—Visits to the works of Messrs. Brown-Firth Research Laboratories, Darwins, Limited (safety razor blade manufacturers), Davy Brothers, Limited, and Samuel Osborn & Company, Limited

1.0 p.m.—Lunch at the Grand Hotel, Sheffield. Tickets 3s. each (members, delegates and ladies).

2.30 p.m.—Motor-coaches to Derbyshire dales (members, delegates and ladies). Tickets 15s. each, including dinner.

Papers at the Conference.

1.—*American Exchange Paper:* "The Properties of Coke Affecting the Cupola Melting of Steel," by J. T. MacKenzie. American Cast Iron Pipe Company, Birmingham, Alabama, U.S.A.

2.—*Belgian Exchange Paper:* "Some Methods of Making Steel Castings," by Monsieur Georges Fosseprez (member).

3.—*French Exchange Paper:* "The Making of Steam Engine Cylinders," by Monsieur Audo, Foundry Manager of the Paris-Orleans Railway Company.

4.—"The Influence of Chromium and Nickel on High Quality and Heat Treated Cast Irons," by Professor Dr. Ing. Piwowarsky, of the Technical High School, Aachen, Germany.

5.—"The Importance of Air Control in Efficient Cupola Practice," by P. H. Wilson, M.I.Mech.E. (member), Foundry General Manager, Stanton Ironworks Company, Limited.

6.—"The Manufacture of a Large Steel Casting," by F. A. Melmoth (member) and T. Brown (associate member), of Messrs. Thos. Firth & Sons, Limited.

7.—"Strains in Non-Ferrous Casting," by C. H. Desch, D.Sc., Ph.D., F.R.S. (member). Professor of Metallurgy in the University of Sheffield.

8.—"The Strength of Cast Iron," by J. E. Fletcher, M.I.Mech.E. (member). Consultant, British Cast Iron Research Association.

9.—"The Effect of Manganese and Manganese-Sulphide in Whiteheart Malleable," by E. R. Taylor, A.R.S.M., F.I.C.

10.—*"High Test Cast Iron," by F. M. Robbins, Chattanooga, Tennessee, U.S.A.

Registration.

Members and ladies attending the Convention will receive, per post, prior to reaching Sheffield, a registration card bearing the member's registration number. This card should be exchanged as soon after arrival as possible at the Convention Office for an envelope containing tickets desired for various functions and visits.

Souvenir Booklet.

A souvenir booklet, giving programme in detail, will be supplied to each member and lady attending the Convention.

Conference Office and Information Bureau.

An office will be open, as shown below, for issue of tickets, booklets, etc., and for general information: Tuesday, 5 p.m. till 8 p.m., at the Cutlers' Hall, and Wednesday, 9 a.m. till 12 noon, and Thursday, 9 a.m. till 10 a.m., at The University, St. George's Square.

Correspondence.

Members may, if they wish, during the period of the Convention, have their correspondence addressed—c/o the Hon. Convention Secretary, as follows:—

c/o MR. W. A. MACDONALD,
Applied Science Department,
University of Sheffield.
Telegrams: "Conference, Applied Science, 42071."
Telephone: 42071.

Correspondence so addressed will be available at the Conference Office.

Catalogue Received.

Coke.—We hope that recipients of the latest piece of publicity issued by the Priestman Collieries, Limited, of Milburn House, Newcastle-on-Tyne, will not receive a similar disappointment as ourselves. We thought it was an invitation to a social function, instead of which it is a well-worded, concise and convincing statement relative to the preparation and properties of Garesfield Beehive foundry coke nuts. This information is set out on the two middle pages of a four-page white glossy cardboard, and in make-up strongly resembles a menu. We understand it is available to our readers on application.

International Congress for Testing Materials, 1927.—An international Congress for testing materials is to be held in Amsterdam from September 12 to 17 next. The Congress will be held in three sections, namely: (1) metals; (2) cement, stone, concrete; and (3) sundries (oils, timber, etc.).

* Owing to additional research work, this paper may not be read until next year.

Important Development in Cupola Practice.

Our representative recently had the opportunity of inspecting the conduct of the Poumay system of cupola practice at the works of Messrs. Kryn & Lahy Metal Works, Limited, of Letchworth. This is the first installation of its kind in Great Britain, and the management are more than satisfied with the results of the preliminary trials and intend converting their second cupola at the earliest opportunity. The cupola, which has been modified was originally a standard model supplied by Messrs. George Green & Company, of Keighley, is slightly taper-lined and averages 39 in. diameter. Before the modification started the furnace was relined to give five tons per hour, but without trouble (or really with trouble, because of the limited capacity of the converters which it serves) six tons per hour is regularly obtained. Before the conversion to the Poumay system 35 cwt. of ganister was used for patching after each day's blow, whilst since, this figure, according to the records of the company, has been reduced to 15 cwt.

The high cost of hematite pig-iron has driven the manufacturers of steel castings by the baby Bessemer process to use larger and larger quantities of steel scrap. The sulphur and phosphorus content has to be kept well below 0.06 per cent. to pass specification. It has been established that scrap of the nature of, say, fish-plates is the ideal for remelting in the cupola, but industrial conditions have imposed upon the manufacturer the utilisation of what approaches the trade category of "heavy steel scrap," and some of the pieces we saw in the scrap yard at Letchworth were of such a character that few would believe its incorporation in cupola practice possible. Nevertheless, the charges we saw made consisted of 75 per cent. of this mixture of heavy and awkwardly shaped steel scrap and 25 per cent. of high silicon hematite pig-iron. The furnace had originally two rows of tuyères, and to these Mr Poumay, when modifying to incorporate his system, added fourteen additional tuyères in spiral fashion, the highest of these reaching to within approximately 4 ft. of the charging door.

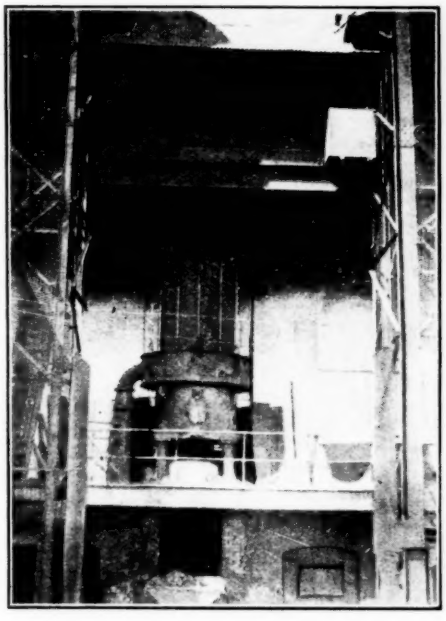
In order to give a proper perspective of the job we quote the figures taken from the daily charge sheets of the firm since the inception of the process on April 26 in tabular form:—

Date.	Weight melted.		Total coke consumed.		Percentage.
	Tons.	Cwts.	Tons.	Cwts.	
April 26 ..	41	10	4	3	11.2
April 28 ..	37	12	6	3.5	12.1
May 2 ..	39	17	3	19	9.9
May 4 ..	34	19	3	19	11.3
May 6 ..	38	2	4	8	11.5
May 10 ..	29	11	3	0	10.1
May 12 ..	30	10	3	8	11.25

The bed charge in every case was between 16 and 18 cwt.

In order to make a fair comparison we detail the output of its sister furnace working on alternate days. This cupola has not yet been converted to the Poumay system:—

Date.	Total metal melted.		Total coke consumed.		Percentage.
	Tons.	Cwts.	Tons.	Cwts.	
April 27 ..	41	1	6	3	15.0
April 29 ..	42	1	6	10	15.4
May 3 ..	38	13	6	10	16.8
May 5 ..	36	2	5	12	15.5
May 9 ..	33	0	5	3	15.6
May 11 ..	34	2	5	12	16.4



FIGS. 1 AND 2.—VIEWS OF A CUPOLA MODIFIED FOR THE POUMAY SYSTEM AT MESSRS. KRYN & LAHY, LIMITED.

The bed coke for this furnace is shown at 22 to 24 cwt.

Thus it appears that though still working under more or less experimental conditions, the system is operating at an 11.04 per cent. total coke consumption, though melting what the ironfounder would call a 75 per cent. semi-steel mixture, whilst its sister furnace requires 15.8 per cent. of coke. Thus a saving of over 30 per cent. has been effected.

The question arises as to whether similar economies could be effected in ordinary jobbing foundries already working very economically. Candidly, the theory underlying the Poumay can admit of many interpretations. One can imagine that had we but two rows of tuyères the coke might be still incandescent and the top row of tuyères would be merely a repetitive action of the lower one, whilst the extension of the tuyère system well up the stack may ensure the complete combustion of any CO evolved from the $CO_2 + C = 2CO$ reaction.

From visual observation at the Letchworth plant we did get the impression that no carbon monoxide was burning at the charging hole. If

our surmise and observations are correct, the economies to be expected, when the system is applied to a British cupola working on normal jobbing mixtures, will relate to the utilisation of perfectly good fuel now passing into the atmosphere. The economies arising from this are an unknown quantity and may vary with every plant installed. Mr. Deschamps, general manager of the Kryn & Lahy Company, informed us that he had just received news that the Chenard et Walcker concern of Paris are melting iron for automobile cylinders with 6 per cent. melting coke. When one considers how important temperature is in this class of business, this suppression of waste CO gas does apparently assume very important proportions. The system has made great headway on the Continent, and the foundry trade will watch with a considerable amount of interest its progress in Great Britain. The process is being handled by British Heating and Drying Company, Limited, 14, Waterloo Place, London, S.W.1.

Institute of British Foundrymen.

NEWCASTLE BRANCH.

As briefly reported in a recent issue, the annual general meeting of the Newcastle Branch was held in the Neville Hall, Newcastle-on-Tyne, on April 30, 1927, Mr. E. Wood presiding. The officers elected were:—As *Branch President*, Mr. Victor Stobie. As *Vice-Presidents*, Mr. C. Gresty and Mr. R. H. Smith. As *Hon. Treasurer*, Mr. H. F. Parsons. As *Hon. Secretary*, Mr. F. Sanderson. As *Delegates*, Mr. C. Gresty and Mr. J. N. Simm. As *Members of the Branch Council*, Mr. F. Allan, Major K. C. Appleyard, Mr. W. J. Molineux, Mr. G. Lillie and Mr. S. Dickinson.

MR. JAMES SMITH said that he thought they should not let Mr. Gresty resign without recording a vote of thanks to him for the work he had done for the Branch. Mr. Patterson said that he had great pleasure in seconding Mr. Smith's proposal. He knew what work Mr. Gresty had done during the Convention and the labour must have been enormous.

On the motion of MR. W. J. PAULIN a vote of thanks was passed to the retiring President and his officers for their work during the session. Mr. Paulin said that they owed the introduction of cinematograph films to Mr. Wood. It must have taken a great deal of courage on his part to make that move because there had been so many doubts as to the success of the innovation.

MR. PATTERSON, seconding Mr. Paulin's proposal, said that he thought the films had been very interesting and that they had shown methods in use at works which the majority of the members, at all events, would probably never have the opportunity of visiting.

Annual Report.

The annual report showed that during the session the Branch held eight meetings, the average attendance being about 90. One of the meetings was held at Sunderland and one at Consett, and included visits to the works of Wm. Doxford & Sons, Limited, and The Consett Iron Company Limited, respectively. At each of these works the members were excellently entertained.

For the first time in the history of the Branch, in addition to the Papers presented, cinematograph films were exhibited at some of the meetings, the thanks of the Branch being due to The British Thomson-Houston Company, Limited, Rugby; Morris Motors Limited, Oxford, and Foundry Plant and Machinery, Limited, Glasgow, for the loan of the films.

The Branch register shows a total membership of 209, a decrease of 23 since the previous report. Four members and five associates have been elected; losses by resignation, transfers and other causes numbering 32.

The annual dinner was held at the Station Hotel on February 12, and was attended by 100 members, ladies and friends.

The General Council awarded a Diploma to Major K. C. Appleyard, member, for his Paper on "The Training and General Position of the Craftsman," read before the Branch on December 12, 1925.

The President and council recorded with regret that, on account of continued illness, Mr. W. G. Hollinworth had been obliged to resign his position as General Secretary of the Institute. They sincerely hoped that his health would soon be restored. At the meeting on January 29 the Branch received a visit from the new General Secretary, Mr. Tom Makemson, when the opportunity was taken to congratulate him on his appointment.

The Junior Section has held four meetings during the session and, in addition, visits have been paid to the following works:—The Carville Power Station, Wallsend-on-Tyne; The Wallsend Slipway & Engineering Company, Limited; and Messrs. Clarke, Chapman & Company, Limited, Gateshead. The annual smoking concert, held on December 10, was very successful, about 58 members and friends being present.

The total membership of the Junior Section is 54, and the average attendance at the various meetings and visits was about thirty.

General Discussion on Foundry Problems.

Following the business meeting, Mr. W. J. PAULIN, Past President, introduced a general discussion on foundry problems, slides being used to explain many of the points under discussion. Among the subjects under discussion were the making of hollow brass handles, steam cylinders, duplex pumps, wheel blanks, and the working of core stoves. Many of the members took part in the discussion which concluded with a hearty vote of thanks being passed to Mr. Paulin.

Book Review.

Kelly's Directory of the Merchants, Manufacturers and Shippers of the World (41st Edition), published by Kelly's Directories, Limited, 186, Strand, London, W.C.2, in two volumes, price 64s., post free.

The contents of this book are, of course, well-known to the commercial world, but in addition to comprising more than one and a half million names, and dealing with over 20,000 places, it is a Gazetteer, and contains a fund of facts and figures of the utmost value to the business man, no matter in what class of merchandise he may be interested.

The book covers the whole world, is copiously indexed in four languages, and is arranged as follows:—Vol. I deals with foreign countries and their Possessions, and Vol. II deals with Great Britain, India and the British Dominions, Colonies, Protectorates, and Dependencies.

That part of Vol. II which deals with Great Britain, has been divided into the following sections:—(1) England, Scotland and Wales: (2) London; (3) Ireland.

Each of these sections is again divided into the following sub-sections:—(*a*) Alphabetical (*b*) classified trades, (*c*) telegraphic addresses, (*d*) exporters, and (*e*) importers.

Reference to any desired information is facilitated by (at the commencement of Vol. I) a concise explanation of the arrangement, and an example of how to use the book.

The whole of the information has been thoroughly corrected and brought up to date.

Death of Prominent Birmingham Business Man.

We regret to record the death of Mr. F. W. Gower, a director of the Birmingham Aluminium Casting Company, Limited; Midland Motor Cylinder Company and the Pneulec Company. The deceased gentleman was extremely active, and was largely instrumental in building up this group of allied businesses which, though comparatively new, already rank amongst the most important foundry concerns in Europe. He was a thorough sportsman, and his loss in foundry business circles will be very keenly felt.

THE PROSPECTUS of the 1928 British Industries Fair, Birmingham, is now available on application to Mr. C. Stanley, general manager, 95, New Street, Birmingham.

German Foundrymen's Association.

The 17th general meeting of the German Foundrymen's Association (Verein Deutscher Giessereifachleute) was held from May 6 to 8 in Berlin. It was preceded by a meeting of the Chief Technical Committee for Foundry Work on Friday, May 6. At a preliminary meeting next afternoon the following reports were read: "A New Process for Testing Moulding Sand," by Herr W. Reitmeister: "Wear in Cast Iron and its Relation to Structure and Mechanical Properties," by Dr. Kühnel; and "The Importance of the Standardisation Movement to the Foundry Trade," mainly a report on the work of the Cast-Iron Material Committee, by Herr Joh. Mehrtens. In the evening the Association was received at the Berlin Rathaus by the Mayor and town council. Some 500 members of the Association and other guests, who included numerous representatives of commerce, manufacture, science, etc., and members of foreign technical associations, were present.

The Mayor, Dr. Böss, welcomed the guests on behalf of the city, and in his address gave an account of the development of the foundry industry in Berlin. The first State foundry, he stated, was established in 1803. It worked with extraordinary success for 70 years, and many of the monuments which were still celebrated had been cast by it. From such small beginnings the foundry trade of the city had grown to its present importance. At present there were in the capital 132 foundries employing an aggregate of 18,000 workers. The number of aluminium foundries in Berlin was actually one-fourth of the total in Germany. He hoped that science and technology would be instrumental in restoring German industry to its former powerful position, and in particular wished success to the German foundry trade and the German Foundrymen's Association.

Dr. Dahl, the President of the Association, expressed the thanks of that body and the other guests for the hospitality accorded them, and remarked that the Association had in its 19 years' existence already held its general meeting 15 times in Berlin.

On Sunday, May 8, the members met in the banqueting hall of the Zoological Gardens for the general meeting proper. Dr. Dahl gave a report on the Association's activities and work during the past year. After thanks had been expressed on behalf of the guests of the Association by Dr. Valentiner, Rector of the Clausthal Mining School, the following technical Papers were read: "The Cupola Furnace in Theory and Practice During Recent Decades," by Dr. Mathesius, Berlin; "The Relations Between the Nature of the Mould and Strength Properties in Alloy Cast Iron and the Green-Sand Casting Process," by Dr. W. Claus, Berlin; and "The Combustion Processes in the Cupola Furnace and the Influence of Auxiliary Powdered Fuel Firing Upon Them," by Dr. P. Bardenheuer.

After an interval for lunch the members reassembled for the transaction of business. The managing committee and council were re-elected, Dr. Humperdinck, Wetzlar, being elected First President and Dr. Dahl, who has been the President for many years, Honorary President of the Association.

The proceedings terminated with a banquet in the Kaïsersaal of the Zoological Gardens, followed by speeches by Dr. Dahl, Prof. Wandhoff, Dr. Geilenkirchen of Düsseldorf, Secretary of the Employers' Federation, and Director Herkenrath, who paid a tribute to the work of Dr. Dahl, the retiring President.

Presidential Address.

In his address the President reported on the activity of the Association in the past year. He stated that notwithstanding the unfavourable economic position in the iron trade and the numerous restrictions which this had imposed upon the foundry industry, the Association had shown a satisfactory development. The number of members had considerably increased and was now about 1,500. The work in the individual groups had again, on the whole, been actively prosecuted. A large number of important lectures, which had nearly all led to an animated exchange of views at the various meetings of the groups, had again been delivered by competent experts, and had helped to familiarise the members with the latest advances on the technical side of foundry work. The suggestion of the Austrian group of the Association to use Vienna gas coke for melting purposes in foundry work was of special importance. Engineer L. Zerzog, a member of the general council, had undertaken the preliminary technical work and tests, and thanks to the co-operation of the directorate of the Vienna Municipal Gas Works, had brought them to a successful conclusion. As a result, and at an expenditure of milliards, the Austrian iron foundries had been rendered independent of foreign melting coke, which was of the utmost importance to Austrian industry.

On the individual technical committees of the Association the utmost activity had likewise been shown. The work of the Electric Furnaces Committee had been successfully continued, its results being embodied in a series of lectures delivered at an extraordinary meeting of the committee in question.

The Moulding-Sand Committee, after completing the first portion of its work relating to the discovery and geological composition of the moulding-sand deposits in Germany, had begun the second portion, namely, the examination and testing of the moulding sands. For this purpose exhaustive investigations according to Reitmeister's process for testing moulding sand had at present been instituted in various large foundries. These promised good results, so that it should be possible, with the aid of this process, for foundries in future to rely upon fixed standard values for their moulding sands and sand mixtures. As a conclusion to its labours, the committee intended to lay down definite rules for the purpose of determining in advance, in connection with any moulding sand, the manner in which it should be prepared, what the drying temperature should be, when the sand should be worked into dry moulds—in short, how the individual sands should be treated in order to obtain the best results and to reduce to a minimum the spoilt castings attributable to the moulding sand.

The Committee for Alloy Foundry Work, whose labours were aimed at placing this section of the trade in Germany on a scientific basis, was working systematically on the existing problems of alloy castings both in the laboratory and in practical work, and was distributing the scientific results obtained in this special field of foundry work by means of a regular system of lectures. The clearing up of the numerous differences of opinion in regard to the various processes of manufacture of high grade cast iron, which had become a real necessity in foundrymen, was engaging the attention of a special committee dealing with this subject.

In the course of the year the Association had also taken a very active interest in the work of the Committee for the Testing of Cast Iron in Railway Work, for the purpose of obtaining data to establish the resistance to wear of cast iron exposed to heat and cold, and its relation to structure and mechanical properties. A number of tests in this field had been instituted and already concluded, and the Chairman of the committee, Dr. Kühnel, Reich Railway Councillor, would report on these to the general meeting. The Association had also taken an active part in standardisation work in the foundry trade, which as would be seen from the report of Herr Mehrtens, had made gratifying progress during the past year.

The Association had also endeavoured actively to support and promote the work of the German Committee for Technical Education in connection with the establishment of a system of instruction for moulders' and pattern-makers' apprentices.

In order to do something to minimise the great hardship existing among unemployed members of the Association caused by the widespread restrictions in the trade, the Managing Committee felt compelled to institute a system of relief for foundry workers, and to publish a fortnightly list giving particulars of existing vacancies. This

step had proved very successful and had already enabled a large number of foundry workers again to earn a living at their trade. It had also proved possible, thanks to the generosity of many members who voluntarily contributed to the relief funds, to relieve a number of specially necessitous workmen and their families by means of money contributions.

As in the previous year, the Association again took part in the work of the German Technical and Scientific Association. In the report on the previous year's work, reference had already been made to the congestion of academic study in the technical high schools of Germany, which led to the Association, having given a detailed statement of the prevalent conditions, to request the Technical and Scientific Association to take suitable measures as soon as possible to remedy this undesirable state of things, which must inevitably cause the ruin of the German engineering trades. The Association had therefore suggested, in the first place, that principles should be laid down which would take account of the conditions existing in the academical and technical labour market, and that by establishing a vocational advice council, the stream of students should be diverted from academic studies into other directions. At its last meeting the Managing Committee of this Association had discussed this proposal and agreed to it unanimously.

The International Meeting of Foundrymen which took place last autumn in the United States, and which was attended by a number of the Association's members, had led to the resumption of that international community of effort which had existed before the war for the examination of technical problems relating to foundry work.

A number of interesting Papers were read, which have been translated and are abstracted below.

The Cupola in Theory and Practice During Recent Decades.

By Prof. Mathesius, Berlin.

Prof. Mathesius gave a comprehensive survey of the very successful scientific experiments which had been carried out in regard to cupola furnaces during the last 20 years, the results at which he had arrived being as follows:—

The melting efficiency of cupola furnaces bears a fixed relationship (which was shown by a diagram) to the amount of the blast per min. and per sq. m. of cross-section which traverses the furnace.

The most favourable melting conditions are obtained with good coke, with a coke charge of about 8 per cent., with which a melting output of 10 tons per sq. m. of cross-section per hour is attained when the amount of the blast is about 100 cub. m. per min. and per sq. m. of section. The results become less favourable, and the temperature of the iron obtainable in the furnace becomes less, both as this amount of blast is increased and diminished.

The result of an increase of the quantity of charged coke is a considerable diminution in the melting output per hour and likewise a lower iron temperature. If the amount of charged coke is diminished there is the danger of the melting zone being too low, and therefore of the iron losses being increased as well as of iron which is rich in gas being melted.

The maximum temperature of the iron which a cupola furnace can give under normal service conditions is within the limits of 1,450-1,500 deg. C. These data appear to solve the problem of the melting of iron in cupola furnaces in all essential points.

A New Process for Testing Moulding Sands.

By W. Reitmeister, Dipl. Eng.

At the outset the author emphasised the importance of testing the moulding sand in foundry work. A precise knowledge of its composition was of special importance to foundries which cast alloy metals, which were adopting to an ever-increasing extent the so-called green casting process, *i.e.*, casting in undried moulds. The methods of testing hitherto employed were but little suited for practical work, for they were not simple enough. Chemical, microscopic and physical methods of testing moulding sand were known. The first two extended mainly to the examination of the material itself, while the physical tests applied rather to the properties of the rammed sand, *i.e.*, of the mould. The testing method under discussion was purely physical. Here the conceptions of bonding strength, ramming strength and permeability to gas played an important part. These conceptions had not hitherto been defined with sufficient accuracy. In particular, the term bond strength had given rise to many erroneous ideas; bond strength, as generally understood, meant the aggregate stability of the rammed sand. That, however, was not merely a consequence of the bonding medium, but also of the ramming work expended. The term "ramming strength" also did not seem free from objection, as it was not entirely dependent upon the work done by the ramming. It would be better to call it "surface hardness." The most suitable process for testing rammed moulding sand would seem to be that which best indicated the properties of the finished mould.

The speaker then gave an unequivocal definition of the term "permeability to gas," and elaborated a formula by which the gas permeability of the rammed moulding sand could be calculated. He then dealt in detail with the relations between packing condition, stability and gas permeability in the finished mould, and pointed out that the amount of packing work imparted to a mould by ramming, vibrating, hydraulic pressing, etc., could readily be ascertained when the same sorts of sand were employed by determining the specific gravity of the moulded body of sand. This should agree as far as possible in machine and hand moulding. The moulding machines must be adjusted to it. With the process described it was possible to test the sand in any condition of packing; at present the energy of 800 vibration strokes 1 cm. in height was employed in packing a cylindrical test body weighing 800 to 1,750 grams with a cross-section of 28.3 sq. cm. This was approximately equivalent to the packing energy expended by a hand moulder in ramming a similar mould in the usual way.

A description was then given of the new process for testing moulding sand devised by the speaker. The gas permeability was determined by placing the sample of sand, packed in a tube, in airtight connection with a tank containing compressed air at a pressure of 0.5 atm. This compressed air was allowed to escape over the packed column of sand, and the gas permeability was calculated, with the aid of the formula mentioned, from the time required for the pressure to drop from 0.5 to 0.1 atm. The stability of the sand in the particular state of packing was then determined in the same sample by means of a shearing test. In the author's opinion this test furnished a good indication of the stability of the moulded sand, as it showed only very slight variations in its results. The testing of the moulded sand for stability and gas permeability could be carried out by a skilled workman within 25 minutes.

In conclusion, a series of photographs was shown for the purpose of indicating the variations to which the sand used in foundries is subject if it is not under constant supervision, how new sands and sand mixtures are tested, and how certain conclusions as to the characteristics of moulding sand can be drawn even from physical examination.

The Importance of Standardisation to the Foundry Industry.

By Joh. Mehrtens, Civ. Eng.

After giving a survey of the initial stages of the standardisation movement in foundry work, the speaker indicated the general progress which had been made in the trade during the last few years, and emphasised the view that this satisfactory development had not yet reached its limits.

In view of the increasing requirements in regard to the quality of castings, the foundry manager was forced to pay the utmost attention to innovations and improvements in foundry work, and while doing so he had to utilise the efforts made

towards standardisation as a means of reducing the cost of his products and increasing the efficiency of his works.

The speaker, who as far back as 1919 had made suggestions for the establishment of specifications for foundry products and had taken a leading part on technical committees dealing with the subject, made special mention of the success recently obtained in the manufacture of high-grade cast iron. For these results, he pointed out, the systematic co-operation of foundrymen and scientific men was responsible, while the technical associations concerned also deserved credit. In order to impart some degree of certainty to these and similar efforts for the production of high-grade cast iron, the establishment of uniform specifications for materials and finished products was now indispensable. Such standardisation brought about a material saving in working and administrative expenses, and consequently also increased efficiency, so that an extension of markets might be anticipated as a result of cheaper products.

The speaker gave a report on the work of the Reich Committee on specifications in conjunction with the German Standards Committee and the Gina Standards Committee established by the Foundry Association, and gave a survey of the raw and auxiliary materials used in foundry work. He said specifications should be laid down for pig-iron, melting additions, non-ferrous metals, alloys, waste materials, scrap, old metal, melting coke, and other fuels, refractory bricks, moulding sand, coal dust, etc., in so far as they did not already exist.

What had been said in regard to quality specifications in the manufacture, sale and use of these materials applied also in regard to the standardisation of the working plant, machinery, tools, etc., in foundries. Technical standards were also being prepared for these, and they were intended to include pattern making, moulding machines and accessories.

In regard to the details of the specifications for foundry products the speaker said that the effects of standardisation were to be seen in an increased degree of certainty in regard to the composition, strength, machinability and appearance of the castings, and not least, moreover, in the reduction of the hitherto prevailing diversity. These advantages benefited both the producer and the consumer and served to eliminate the feeling of excessive subdivision in consuming circles. These points were illustrated by photographs relating to the introduction of standardisation in practice.

Present Position in Germany.

The speaker described the present position of the standardisation work in the four groups of materials relating to foundry products: Cast iron, malleable iron, cast steel and non-ferrous metals. The standardisation sheet entitled, "Cast Iron," dealing with its classification and properties as a working material, was ready for submission to the Management Committee. The sheet entitled "Malleable Iron" was also in the draft stage, so that both these sheets would presently be subjected to criticism. The sheet on "Cast Steel," however, had been practically completed, although it might still be subjected to certain slight modifications.

Herr Mehrtens said that the specifications for non-ferrous metals and alloys presented considerably greater difficulties. These were being worked out by the Technical Standards Committee for Non-ferrous Metals, in conjunction with the German Metallographical Society, and the industrial associations, official bodies and institutions concerned in the study of metals. The speaker also dealt with the important question of the introduction of standards into practice.

The lecture furnished a clear survey of the work already carried out in standardisation in relation to foundry work. Dr. Mehrtens concluded his very noteworthy observations with the hint that while the work might be delayed by certain obstacles, it could not be prevented from going on. It was the duty of everyone engaged in manufacture and commerce—producers, dealers and consumers alike—to eliminate by healthy criticism the defects still existing in the specification, and to hasten the introduction of specifications for the benefit of German industry.

Combustion Processes in the Cupola and the Influence of Auxiliary Powdered Coal Firing.

By Dr. P. Bardenheuer.

Dr. Bardenheuer said that the purpose of the cupola furnace was to remelt cast iron and to bring it into a satisfactory condition for casting, whilst utilising the fuel to the best possible advantage. The melting output and the thermal efficiency of the cupola furnace were greatest when combustion was effected as rapidly and completely as possible, and the heat developed could be conveyed to the iron without considerable losses. Conditions relating to the nature of the furnace as well as to the particular service conditions existing frequently affected the working of the furnace more or less prejudicially. Considerable heat losses were caused in particular owing to the carbon of the coke charged being converted only into carbon monoxide instead of into carbonic acid, or by the carbonic acid rising in the furnace being converted into carbon monoxide under the action of the dropping coke.

It was the object of auxiliary firing by powdered coal (the invention of Dr. A. Kaiser, chief engineer of the German Babcock & Wilcox Steam Boiler Works, of Oberhausen, Rhineland) to mitigate these disadvantages, as well as to reduce, by accelerating the melting process, the general heat losses by radiation and conduction.

By blowing in a portion of the fuel in the form of powdered coal a little above the blast tuyeres in the furnace, a very great heat was developed locally in the melting zone, and thus an increase of temperature was obtained. It was to be assumed that a better combustion of the coke was thereby simultaneously caused. The complete utilisation of the coke and the replacing of a portion of it by dust enabled the coke charges to be considerably reduced, so that less coke came into contact with the ascending hot gases, and the losses through the formation of carbon monoxide from the carbonic acid were diminished.

Economies Attained.

The powdered coal was blown into the combustion zone of the furnace through three special tuyeres by means of compressed air at 2.5 to 3 atm. +. The amount was approximately 1 per cent. of the iron charge. The firing was also started with dust. The course of the melting was examined by two comparative tests with and without supplementary firing with an output of about 30 tons at a time in a furnace with an internal diameter of 900 mm. The results enabled accurate data regarding materials and heat utilisation to be drawn up. The most important results were as follows:—

In the first test the consumption of melting coke was reduced from 10.70 to 6.80 per cent., and in the second from 10.88 to 6.80 per cent., the consumption of powdered fuel being 0.93 and 0.79 per cent. respectively. The total saving in fuel, including melting and bed coke, was 28.84 and 31.41 per cent. respectively. The temperature of the molten iron was in the first test, without dust, 1,350 deg. C., and in the second 1,400 deg. C.; while with powdered fuel, in the first test it was 1,365 deg. C. and in the second 1,395 deg. C. The melting output per hour was increased by the auxiliary firing from 5,267 to 6,889 kg., that is by 30.8 per cent., and from 6,203 to 7,629 kg., that is by 23 per cent., respectively. The thermal efficiency, that is the ratio of the heat content of the molten iron to the quantity of heat which would have been obtained by the complete combustion of the fuel used into carbonic acid, rose in the first test from 37 to 50.74 per cent. (increase 37.14 per cent.), and in the second test from 34.76 to 47.77 per cent. (increase 37.43 per cent.).

In the analysis of the waste gases the improved utilisation of the fuel owing to the supplementary firing was shown by a reduction of the carbon monoxide content by 45.5 and 38.5 per cent. respectively.

No increase in the iron losses was found. These amounted in both cases to an average of about 0.3 per cent. By the auxiliary firing the sulphur content was reduced, according to the mean results of 300 to 400 analyses, from 0.107 to 0.87 per cent., that is about 19 per cent., because of the smaller consumption of coke.

The quantity of slag was in both cases diminished by 8.22 and 18.94 per cent. respec-

tively. According to the results of the tests in question, as well as numerous service tests, no effect upon the mechanical properties was exercised by the new process.

According to very recent tests it was possible to carry out the melting process with auxiliary firing so as to obtain with certainty, in ordinary practice in the cupola furnace, high grade cast iron with a transverse strength of 46 to 58 kg/mm², with a deflection of 10 to 13 mm., and a tensile strength of 28 to 35 kg./mm². The value of the new process, which presented noteworthy advantages in regard to economising fuel and time, was thereby considerably enhanced.

The Relations between the Nature of the Mould and Strength Properties in Alloy, Cast Iron and the Green Sand Casting Process.

By Dr. W. Claus.

The subject of this paper was the physical properties of castings in relation to the nature of the mould employed. Dr. Claus said that so far little had been done to elucidate this question. It was, however, of very special importance to foundries producing alloy castings that the subject should be studied, as at present efforts were being made very widely to substitute the green mould casting process for the dry casting process in general use.

For this purpose Dr. Claus, in co-operation with Herr Fritz Goederitz, had carried out a series of experiments with pure aluminium castings, an Al—Cu—Zn alloy and an Al—Cu alloy, on the results of which he now reported. Material cast in chill moulds and in green and dry sand moulds was tested, and figures relating to hardness, tensile strength, expansion and shock resistance were ascertained. The influence of the nature of the mould on the structure of the different materials cast was also examined.

The tests showed that on the average the physical properties of material cast in green sand were slightly better than those of material cast in dry sand. The physical values of chill castings were considerably superior to those of both methods of sand casting.

Summarising the results, it might be said that from the mechanical and technological point of view there were no objections to the introduction of the green mould casting process by alloy metal foundries.

Wear in Cast Iron and its Relation to Structure and Mechanical Properties.

By Dr. Kühnel, State Railway Councillor.

Dr. Kühnel stated that a committee for testing cast iron in railway work had been formed by the German Ironfounders Employers' Federation, the Foundrymen's Association, and the Locomotive Union, in combination with the German State Railway Company. The object of the committee was to obtain data for determining the resistance to wear of cast iron when subjected to heat and cold, and the relation of such resistance to structure and mechanical properties. In carrying out this purpose, the committee had the opportunity of influencing in any way it might desire the laboratory and works tests of the State Railway Company, both as regards the carrying of them out and the calculation of results. The following were the tests made:—

For brake blocks: (1) Major test on the Wannsee railway with ten trains fitted with brake blocks of different makes, and (2) Laboratory test with the same brake blocks or their counterparts at the Grunewald brake testing office and the mechanical testing department of the State Railway Central Office.

For valve bushes and rings:—(1) Major test by equipping T12 locomotives with valve bushes and rings of different hardpesses and origins, with two kinds of oil, at the Grunewald locomotive testing department; (2) Test of the parts in regard to mechanical properties, structure and chemical composition at the mechanical testing department of the State Railway Central Office, and (3) Test of all valve bushes rejected from service as insufficiently wear-resisting, in respect of mechanical properties and structure.

For grate bars:— Equipment of S10 locomotives with grate bars with different P-contents, and their comparison with grate bars with a P-content of about 0.8 per cent.

The tests for brake blocks and valve bushes and rings showed conclusively that soft ferritic cast iron is not resistant to wear, and that it even subjects harder cast iron to fairly severe wear. The best bearing is obtained if the parts running against each other are of approximately equal hardness and have a pearlitic structure, but in the particular case of valve bushes and valve rings the bush must be rather harder than the ring.

The result of the tests for grate bars was as follows:—The possibility of the ash of certain coals, the penetration of sulphur from the coal into the grate bars and the considerable alteration of structure in the bars owing to the heat, constitute destructive causes which presumably affect detrimentally their resistance to wear more seriously than a high S and P content. In view, however, of the mechanical stress to which the grate bars are subjected and the danger of fracture it is nevertheless desirable that the P-content should not be too high.

Portsmouth Foundryman's Decease.

We regret to have to record the death of Mr. B. F. Sperring, managing director of Messrs. W. H. Sperring & Company, Limited, of Albion Foundry, Clarendon Street, Portsmouth. The deceased gentleman was the chairman of the local engineering employers' federation, and was not only held in high esteem locally, but was one of the most popular members of the Institute of British Foundrymen. He joined the British Foundrymen's Association immediately after its incorporation, and there has never been a more regular attender at its annual meetings. He was actually a member of the London Branch, but obviously distance prevented his regular attendance at the Branch meetings, but he followed its progress with considerable interest, and only last year took it upon himself to invite his fellow members to his home town, where the esteem with which he is held by the Royal Dockyard authorities ensured a cordial reception.

On behalf of the foundry industry, we tender to Mrs. Sperring and their family most sincere sympathy on the loss of one who commanded esteem and affection from all with whom he came in contact.

Foundry Statistics.

During March Germany imported 4,261 metric tons of castings and exported 18,607 tons. Pig-iron imports stood at 12,332, and the exports at 35,730. Similar figures for the first three months of this year read 16,830, 50,349, 34,627 and 99,660.

The German pig-iron production during April was 1,051,872 metric tons (as compared with 668,211 tons in April, 1925). It included 92,331 tons of foundry iron.

During 1926 Italy imported 176,724 metric tons of pig-iron, 10,969 tons of cast-iron pipe and 10,373 tons of other iron and steel castings. These figures in 1925 were 265,055, 8,358 and 7,973 tons respectively.

The U.S. pig-iron output in April was 3,422,226 or 114,074 tons per day as against 112,366 tons per day in March.

The pig-iron output of Hungary in 1926 was 187,813 as against 93,283 tons in 1925.

The foundry departments of the iron and steel trades were employing 8,299 workmen during April —a gain of 0.6 per cent. over March.

Sheffield Merchant's Unpleasant Experience.

Mr. T. H. Watson, the well-known alloy merchant of Sheffield, accompanied by Mrs. Watson and their daughter, have arrived in England after an extended holiday. They had a terrifying experience in Mexico, when the train in which they were travelling was held up by bandits, who killed about sixty of its occupants. Miss Watson, on this occasion, showed conspicuous bravery. We congratulate Mr. Watson and his family on their lucky escape and safe return.

The Iron and Steel Exchanges.

Their Functions in Modern Industry.

At the City of London College, Moorfields, London, a lecture on "The Iron and Steel Exchanges and their Functions in Modern Industry" was recently delivered by MR. J. C. SUMPTION (Secretary of the London Iron and Steel Exchange), in connection with an adult class which has been conducted through the winter months by Mr. T. Barton Kelly, who presided at the lecture.

At the outset the lecturer said that in considering the requirements of a modern Exchange, it was necessary to review the positions which such institutions had held in the past; to consider the changes which had taken place in the conduct of business; to decide whether existing Exchanges fulfilled the needs of modern commerce, and, if they did not, what changes were required in their constitution to fit them to play a useful part in the business life of to-day.

Some Provincial Exchanges.

Birmingham Exchange.—Proceeding to describe briefly one or two of the more important existing Exchanges in the Provinces which were more especially associated with the iron and steel trades, the lecturer remarked that the Exchange which had played the most prominent part, probably, in the iron and steel trades was the Birmingham Exchange. This was founded in 1861 as a meeting place for manufacturers and merchants engaged in the local industries, the principal of which were then, as now, coal, steel and other metals. No official prices were quoted, the business transacted being conducted privately between members on the floor of the Exchange. This institution, however, had one outstanding feature in which he believed it differed from all other British Exchanges. That was its Quarterly Meetings. These meetings were held on the second Thursday following Quarter Day, and were attended by traders interested in iron and steel from all over the country, who went to Birmingham with a view to discovering the tendencies of the market by talking over business affairs on 'Change. This custom originated in the middle of the 19th century, when the ironmasters of the Black Country met each quarter in Birmingham to fix the prices for their products for the ensuing three months. This practice had largely fallen into disuse, as the market for iron and steel fluctuated more rapidly than of old, and was governed by many more extraneous circumstances than was the case in the 'fifties and 'sixties.

Manchester Exchange.—Dealing next with the Manchester Exchange, the lecturer described it as one of the largest and most important Exchanges in the world; though the business done in metals was only a small proportion of the total. The greater number of the members were engaged in the cotton, textile and other industries. Anyone visiting the huge hall in which the Manchester Exchange was held could not be otherwise than impressed by the attendance, running into many hundreds. The numbers engaged in trading in iron and steel, however, were comparatively small.

Middlesbrough Exchange.—This Exchange, which was formed in 1864, was principally devoted to iron and steel, although it was also frequented by shipowners, shipbrokers, colliery owners and merchants dealing in general merchandise. The notable feature of this Exchange from the point of view of the iron and steel trades was the weekly iron market, and the tendency of this market was watched with keen interest by those interested in pig-iron.

Swansea Exchange.—This was founded in 1887, and met on Tuesdays. It was attended by the South Wales tinplate merchants and manufacturers, as well as members of other branches of the iron and steel trades. The former, however, were in the majority, and this institution might almost be described as a tinplate market.

Glasgow Exchange.—This was open to all the industries carried on in that great commercial centre, and members of the local iron and steel trades attended among others. This Exchange had an interesting history inasmuch as it was the scene of the old Glasgow Iron Ring, which was formed in 1848 and was concerned solely in dealing with pig-iron warrants; but of that more presently.

London Exchanges.

London Iron and Steel Exchange.—This Exchange, Mr. Sumption said, was formed in 1919. Hitherto it had had no home of its own. It first met in a big room at the Cannon Street Hotel, and afterwards—up to the present time—rented for one day a week the London Metal Exchange rooms in Whittington Avenue. There was now under consideration a scheme for making the Exchange a daily one, and possibly running a luncheon club in connection with it. The London Iron and Steel Exchange was the youngest of the Exchanges, and was in process of adjusting itself to the developments and requirements of modern commerce, perhaps to a greater degree than any other similar body.

London Metal Exchange.—This Exchange, although not connected with the iron and steel trades, was closely allied to them. So far as non-ferrous metals were concerned it was the most important Exchange in the world. Its quotations practically set the world prices of metals for the day, and the business carried on there made London the leading non-ferrous metal market of the world. Before 1869 the London metal merchants met at the Royal Exchange; but later obtained premises of their own. It was not until 1881, however, that the present premises in Whittington Avenue, Leadenhall Street, were erected. From that day the London Metal Exchange had grown in importance; but the class of business which was conducted there could not be compared with anything that was carried on at any of the Exchanges where iron and steel business was mainly transacted. The nearest approach to the London Metal Market was the old Pig-Iron Warrant market, to which he had referred. Although that market had been closely identified with Glasgow, a similar market was held on the London Metal Exchange.

Pig-Iron Warrants.

Both the London and Glasgow markets in pig-iron warrants came to an end in 1916 when Government war-time legislation brought an end to speculation in iron. Since that date there had been no properly organised market in which speculative transactions in that commodity could be carried out, or any market in which a producer of iron and steel could hedge against the orders he had taken. A producer of pig-iron could not now place his surplus production of pig-iron in a warrant warehouse and by selling the warrants on the market avoid the expense of carrying stocks. It was only fair to say that many of the producers believed that the old warrant iron market was too much at the mercy of speculators, and that as a consequence fluctuations in prices were unnecessarily violent. All the dealings in pig-iron warrants were public, and the prices made in the Glasgow and London iron markets were telegraphed daily all over the country and to the foreign centres interested in the buying of iron and steel, so that the price of the London and Glasgow rings exercised a paramount influence upon the quotation for pig-iron—a circumstance that at times must have been irritating to the manufacturer.

The lecturer added that he had been informed that, apart from other reasons, the great increase in labour charges since the war was an insuperable obstacle to reconstituting the market. In many ways the old warrant market served a useful purpose. For instance, had it been in existence during the strike last year it would probably have mitigated the effects of that dispute upon the iron and steel trades. On occasion there were 500,000 tons of Cleveland iron alone in warrant stores,

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so the magnitude of the business conducted in the market could be imagined.

Changes in Recent Years.

From the foregoing review of existing Exchanges it would be seen that most of them were running on much the same lines as they were when they were first formed many years ago. But during that time the conditions under which business was transacted had changed to an extraordinary degree. It was difficult for us to-day to conceive the business conditions which ruled in the 'sixties and 'seventies when the Exchanges were built. Telephones were in their infancy. Great Britain was very largely the workshop of the world. Money was cheap and business enterprise was probably at its zenith. The Exchanges of those days met an obvious need. They enabled the business man to obtain trade information, to buy or sell and to save an enormous amount of time by cutting down the labour he would otherwise have had to expend in making calls and writing letters. The habit of attending the Exchange was almost universal in those days; but even then there was in process of development an invention that was destined to play a greater part in their decline than any other factor. It was in 1877 that the possibilities of the telephone as an aid to commerce was first recognised. As its development grew, some of the necessity for personal contact between traders on 'Change disappeared. The older generation of those days kept up the habit of attending 'Change; but the younger and succeeding generation, brought up in a business atmosphere vibrating to tinkling telephone bells, relied more and more on that invention for conducting business quickly, and—sometimes—efficiently.

Another cause operating to a changed attitude on the part of business men towards the Exchanges was the greater initiative displayed by trading concerns in later years, in setting up branch offices in the principal trading centres, and particularly the increase by manufacturing concerns of the personnel of their selling staffs. It was under the stress of competition that the policy of increasing and perfecting selling organisations by British makers was undertaken. One effect of this had been that the merchants had found that by sitting in their offices they could keep in touch with the producing firms with much less trouble to themselves. This was particularly the case in the export trade. Those who were acquainted with export merchants' offices would sometimes see representatives of three or four steel makers waiting to interview the merchants' buyer. The export merchant, however, had the excuse that the increased cabling facilities compared with those existing years ago required a closer attendance at the office. One or two days a week used to be called "mail days," but under present trading conditions every day might be said to be a "mail day" in a merchant's office. These were some of the principal reasons why there was less willingness on the part of some buyers to attend Exchanges, and it applied to a greater or lesser degree to all the Exchanges in which iron and steel business was conducted.

The Future of the Exchanges.

In the future, Mr. Sumption thought, these commercial Exchanges would have a greater part to play in the iron and steel trades. We were passing through a period of trade re-organisation. It was an age of trusts, associations and amalgamations on the part of producers. Merchants, from the nature of their trade, were less able to combine, and less willing to amalgamate, than the manufacturing side of the trade. This was easily understood, as the distributors' business was by its very nature an individualistic one. On the other hand, manufacturers were seeking by every means in their power to reduce competition, costs, expenses, and to maintain prices. Many of the movements of the manufacturers had resulted either directly or indirectly in curtailing the ground which the merchants had hitherto considered to be their own. He thought that the unequal situation which had existed in the world's markets for some years past had been the chief driving force in bringing about these attempts at industrial co-operation. For years now it had been a buyers' market. The sellers had had to do the running about and the buyers had been in a position to bestow their favours where and as they chose. Surely, it was obvious that one of the inspirations of this policy of combination was to regain some measure of equality between sellers and buyers, and in such an event the utility of the Exchanges would be amply demonstrated.

There was, however, a function which he thought would fall to a properly conducted Exchange which would be more important than that of providing a convenient place for the transaction of business. The recent combinations of traders, particularly on the Continent, had been what was known as "horizontal" rather than the "vertical," as had been the case before the war. The tendency now was for firms carrying on a similar business to coalesce; as, for instance, among pig-iron manufacturers, the producers of semis and of finished materials such as wire nails. If one looked around it would seem that at home and abroad all branches of the trade were seeking to find prosperity in combining in cartels, associations, and similar bodies. Of late there had been signs that some at least of the buying departments were inclined to adopt similar methods. Whilst such selling organisations would no doubt do much to reduce competition between the firms included in them, they would also divert it into fresh channels. By that he meant that instead of active competition between individual firms there would be intensified competition between large organisations. He did not believe that the private firms would cease to exist, even under such circumstances, but he thought that the day of large combinations of traders had come. He suggested that it would be a vital necessity under such conditions for all these various bodies to find a common neutral ground, and he looked to the Exchanges of the future to provide this.

The governing body of such Exchanges should be formed of people elected by the trade irrespective of any special organisation or department of the industry with which they were connected, and as such they should be in a position to legislate, if required, for the various groups. It seemed to him that nothing but chaos could result from a position in which various influential trade bodies were fighting merely for their own ends in the world's markets, without regard to the rights or susceptibilities of other producers, distributors or consumers.

Company Reports.

Whessoe Foundry and Engineering Company, Limited.—Dividend, 10 per cent., less tax.

Tweedales & Smalley (1920), Limited.—Net profit, £74,389; dividend, 15 per cent.; carry forward, £74,798.

Union Steel Corporation (of South Africa), Limited.—Profit, £41,111; total credit balance, £82,525, carried forward.

J. Stone & Company, Limited.—Net profit, £180,011; brought forward, £67,075; total, £247,086; reserve, £45,133; ordinary dividend, 10 per cent. per annum, and bonus 1s. per share; carried forward, £72,892.

British Thomson-Houston Company, Limited.—Balance, £335,384; brought forward, £220,126; interest on debentures and loans, £149,724; depreciations, etc., £115,319; preference dividend, 7 per cent. per annum, less tax, £84,000; no dividend on ordinary; carried forward, £226,467.

Siemens Brothers & Company, Limited.—Profit, £358,990; debenture stock, £67,439; preference dividend, £55,000; income-tax, £16,187; final dividend, 5 per cent. on ordinary shares, making 7½ per cent. for year; brought in, £196,140; carried forward, £266,504.

Brush Electrical Engineering Company, Limited.—Depreciation, £15,556; net profit, £62,887; general reserve, £5,495; dividend, 10 per cent. per annum, £46,512; 4 per cent. interest on prior lien debenture stock, £2,044; surplus for apportionment between shareholders and co-partners, £8,835.

The partnership heretofore subsisting between Messrs. H. S. Myers, C. K. Ingle, and J. H. Rhodes, engineers, millwrights and machinists, Star Works, Wortley, Leeds, under the style of Myers Brothers, has been dissolved.

Discussion on Foundry Problems.

RATE FIXING IN THE FOUNDRY.

At the annual meeting of the London Branch of the Institute of British Foundrymen, MR. J. W. GARDOM introduced the question of rate fixing—the importance of which he emphasised—and described a system he had in vogue for fixing fettling rates. In his opinion, the success of any firm depended upon good rate fixing, the chief reason being that by good rate fixing an employer was able to keep his workpeople satisfied; in addition, it helped the costing system. One advantage of a costing system was that it enabled an employer, if he lost money on one job, to make good the loss on another job. But the workman was not in that position; he might be doing one job throughout the whole week, and he might get a very bad week or else a very good week—in which latter case he would not work so hard, for fear that his employer might cut his rate.

The problem he (Mr. Gardom) would put forward was how properly to fix a rate for fettling. During the past week some 20,000 castings per day had been made at the foundry with which he was concerned, and he had fixed a definite rate for fettling. He did not say that his formula was the right one, but it was one which he was applying. His formula was to add to the rate per hour the square root of the weight of the casting in pounds; then to take the weight removed from each casting, in pounds, and divide it into 1.75, and multiply that by the weight of one casting (in pounds). That would give the number of pence per pound paid to the workpeople:—

$$\frac{\text{Rate per hour} + \sqrt{\text{casting in lbs.}}}{\frac{1.75}{\text{Wt. removed per casting, in lbs.}}} \times \text{Wt. of one casting, in lbs.}$$

It could be worked out to give the rate per casting. All that was necessary was to count the castings and weigh them before and after grinding, and then work it out. He had been working the system successfully for a year, for castings weighing from about 0.01 lb. up to 20 lbs. Usually, of course, one had a number of castings and obtained an average. As an example of the working of the formula, he took the case of a casting which, after grinding, weighed 9 lbs. The loss in weight during grinding was 0.002 lbs., which was divided into the 1.75. That latter figure had been obtained practically, and was dependent absolutely upon the material being ground and the wheel it was being ground with. The result of dividing 1.75 by 0.002 lb. was to give a figure of 8.75 (say 8.8). Multiplying the latter by 9 gave 79.2 (say 79). Taking the grinding rate per hour as being 1s. 4d., *i.e.*, 16d., and adding to the 16 the square root of 9 (which was 3), the figure arrived at was 19. By dividing 19 by 79, he arrived at the figure of 0.24d., which was the grinding rate per lb. One advantage of the system was that if, for example, the average rate had been 0.2d., and one suddenly obtained an average rate of 0.5d., it was obvious that there was something wrong, and one could then go for the pattern makers for leaving too much on. There were other advantages also.

The figure of 1.75 was obtained by pressing the material for a definite time on to the wheel which was being used.

The method had the merit of having worked satisfactorily: the workpeople were getting more money, the employers were getting more work, and everybody was happy as the result.

Complicated Formulæ Disliked by Operatives.

MR. M. J. COOPER said his experience was that systems such as that put forward by Mr. Gardom, which involved a good deal of calculation, gave rise to doubt in the minds of the workmen as to whether they had been treated fairly. The men hesitated when so much calculation was involved; they could not work the thing out for themselves, and were not sure about it. What they wanted was a price in £ s. d. When he was calculating a rate for dressers, he had first arrived at the time taken to remove a certain thickness of fin over a foot. That would vary in accordance with the hardness of the material and of the wheel used. The men, however, did not care for that sort of thing; what they wanted was a price in £ s. d. In the case of small castings such as Mr. Gardom had mentioned, one might observe how much the men could do in a particular time; then one could allow a certain time, say 2½ hours, for a barrow-load of castings of different types.

MR. A. W. G. BAGSHAWE asked Mr. Gardom how his system applied to a casting weighing 2 or 3 cwts.

MR. W. B. LAKE congratulated both Mr. Gardom and Mr. Bagshawe on the fact that they always endeavoured to get their calculations on to a scientific basis. That was all to the good, but, on the other hand, it was possible to become too scientific, and he asked Mr. Gardom what he considered to be the advantages of his system over that of allowing a reliable man to grind a dozen castings, ascertaining how much that reliable man could do in an hour, and then basing the piece-work rate on the ascertained facts.

Individual Apportionment Preferable.

MR. A. F. GIBBS suggested that probably the reason why Mr. Gardom's system had been applied with success was that, whereas previously the fettlers were grouped into gangs, to-day each one was working independently. It was his own experience that the best results were obtained in that way; when the men worked in gangs, one would rely on another, and so on. He was rather pessimistic as to the application of the system to castings having many cores, the removal of which occupied quite a long time.

MR. G. C. PIERCE asked Mr. Gardom whether his system had been put to the men, for their acceptance or rejection, before it was put into operation, and whether, since the system had been in operation, any of the men had had the "nerve" to approach him and discuss it with him. He was rather inclined to think that they must be a very docile set of men to accept such a system—which he would guarantee they did not understand. It would appear, to one who could grasp the system, that it would certainly be applicable in cases where the nature of the work did not vary to any great extent, but, if there were any great variation in the nature of the work, the system would be unworkable.

System Shows Advantages.

MR. GARDOM, replying, said that the men had discussed the system, and all they had said was "Thank you." The whole basis of the scheme was the figure of 1.75, and that was the figure obtained by the method he had already indicated, when working with malleable iron, which was the material he was working with. For brass the figure would be, he believed, about 3.5; at any rate, it was a higher figure than that which applied to malleable iron. Possibly, in arriving at the figure of 3.5, he had used the wrong grinding wheel, but it was not worth while buying a special wheel for the small amount of brass that had to be dealt with. In reply to Mr. Bagshawe, he said that the heaviest casting to which he had tried to apply the system weighed 100 lbs., and that 100-lbs. casting was responsible for the square root. The system did not work out quite right for a 100-lbs. casting, but, with the square root in, it did work out quite satisfactorily for castings weighing up to 36 lbs. Naturally, of course, the younger workpeople were dealing with the smaller castings, and the older and more experienced workpeople dealt with the heavier castings, and that came into consideration, of course, with the rate. Replying to Mr. Lake's question as to the advantages of this system over one based on the amount of work which a reliable man could do in a definite time, he said that the greatest advantage, so far as he could see, was that by weighing any individual casting accurately before it went into the fettling shop he could say what the rate would be. Surely it was an

advantage to know what a job was going to cost? If one had a system by which the rate was based on the amount of work a man could do in a definite time, there was always the possibility that the man might spoil the system by slowing down. He considered that the fault with regard to rate fixing at the presnt time was that one did not pay a man sufficient for it. He did not mean to imply that rate fixing was a wonderful job, but one usually paid the rate fixer the same as the foreman, and he had to keep on good terms with the foreman, fearing that he might lose his job if he were not careful. He (Mr. Gardom) knew of cases where, if the rate were not fixed, the foreman would tell the men not to work too hard. The system which had been described was applicable to fettling only, and to nothing else. The cleaning out of cores, and so on, was dealt with as a separate department, but such a system as had been described could be made applicable to that. As to the effect of the system upon the wages of the men, he said that the average rate of one particular section had been increased by just over 25 per cent. With regard to the suggestion that the system was complicated, he said he had one or two girls who could neither read nor write, but they could work out the rates under this system just as well as he could do it himself. Another advantage of the system was that if the rate arrived at were too high—it could not be too low—the fact could be detected and the matter rectified before the job went into the shop. That was better than detecting it after the casting had been sold, and finding out then that money was being lost on the job. He disagreed with the suggestion that the scheme was highly scientific. Apparently, Mr. Cooper would prefer that a definite rate per cwt. should be fixed.

Mr. Cooper said his point was that the men regarded a scheme such as that described, and which involved a good deal of calculation, with a certain amount of suspicion, and preferred to have a certain rate fixed for the job. At the same time, he believed it was possible to find a basis figure, such as the 1.75, provided the shop was engaged more or less upon repetition work, but whether the men would accept it was another thing. It would not pay to apply such a scheme where jobbing work was being carried out.

Mr. Gardom said he could only repeat that his workmen were quite pleased with the scheme. It was easy for them to work out their earnings: for instance, if the rate were 0.2d. per lb., it was easy to see that it would be 2d. for 10 lbs. He had known cases in which men who had been engaged upon a particular job for only an hour had come to him and said that they were not making money on it. As to the suggestion that the scheme would not apply in a jobbing foundry, he said he considered that his foundry was a jobbing foundry, in the sense that the jobs had to be changed frequently. A foundry in which the jobs were changed once, twice or ten times a day, he regarded as a jobbing foundry.

THE MAKING OF SOUND BUSHES.

The next problem was put forward by Mr. A. F. Gibbs, and concerned the making of bushes. In the making of them, he said, he did not conform strictly to metallurgical procedure. The bushes (samples of which were produced) were of about 6-in. diameter. They were moulded in green sand, with green-sand core. The method of gating was to use a downright, with a runner at the side.

The mixture, as put into the pots, consisted of 16 lbs. of copper, 2 lbs. of tin, and 1½ lbs. of zinc, the remainder, making up the weight to 120 or 130 lbs., being firebox scrap, or its equivalent. The analysis of the metal ultimately was supposed to be approximately, copper, 85 per cent.; tin, 10.5 per cent.; and zinc, 4.5 per cent. Taking the case of three bushes, cast from one 130-lb. pot, the first was cast at a temperature of 1,300, the second at 1,200, and the third at 1,050 deg. C. The bush cast at the highest temperature—which was sometimes much higher than 1,300 deg.—was sound; the second, cast at 1,200 deg., had a slight crack; and the third, cast at 1,050 deg., had a very bad crack. The problem was how to produce a sound bush when pouring at the correct pouring temperature, viz., 1,200 deg. C.

He had put the problem before several gentlemen, and two or three of them had suggested, first of all, that the crack was a hot crack. His reply, however, was that he did not think that could be the case, because the higher the pouring temperature the more sound was the casting produced. Then they had suggested that the crack must be a cold crack, which meant a cold shut. His reply to that was that he knew the difference between a crack and a cold shut, but he would now leave it to the meeting to decide what the trouble was.

Arsenic as Cause of Defective Bushes.

Mr. J. W. Gardom said that when he had been concerned with railway work the copper used for fire bars contained 0.5 per cent. of arsenic, and he was wondering whether there was 0.5 per cent. arsenic in the copper used by Mr. Gibbs. He asked whether the high temperature was attained in order to volatilise the arsenic and so get rid of it. It was hard to believe that the temperature of 1,300 deg. C. was attained. He did not suggest that Mr. Gibbs was wrong, but that the pyrometer might be, and he asked, therefore, how the pyrometer was used, and whether it was a thermo couple.

Mr. Gibbs said there were two thermo couples used, one checked against the other, immersed in the liquid.

Mr. Gardom said he had never yet met with a base metal couple which would read at above 800 or 900 deg. accurately. Couples were being sold at present to work up to 1,100 deg., but he had not heard of one to read above that. If there were such a couple, he would like to know the name of it.

Mr. G. Hand, referring to the analysis, suggested that there were more constituents in the mixture than the three indicated, viz., copper, tin and zinc. Old scrap might contain anything, and most railway firebox bars, and so on, were made of arsenical copper. At the same time, he did not think that 0.5 per cent. of arsenic would cause the difference in the results which Mr. Gibbs had mentioned; indeed, that percentage of arsenic might not alter the test figure at all, but the bismuth content of the mixture might be higher than that. Again, although the copper was not oxidised properly, the trouble might be due to oxygen. Another point that occurred to him was that the crack might be due to oxidised metal, although the temperature was only 1,300 deg. C. Until the casting was fractured right through, however, one could not tell.

Pouring Temperature thought to be high.

Mr. G. C. Pierce disagreed with Mr. Gardom's contention that base metal thermo couples were not reliable for reading temperatures up to 1,300 deg. C. He himself had two base metal couples, which he was using every day, and could rely upon to show the temperature approximately—*i.e.*, to within 5 deg.—up to 1,300 deg. C., provided, of course, that reasonable care was taken to see that they were in good condition. In his view, part of Mr. Gibbs' trouble was due to pouring at too high a temperature, particularly when one had in mind the size of the job, and he would never allow such metal to exceed 1,280 deg. C. for anything. He would not permit the metal to be poured at a temperature above that even in the case of work only 1/10th-in. thick. If he were asked what was the correct pouring temperature for a job of this character, he would say that it was in the region of 1,200 deg. C. He would not care to go below that, in view of his experience of the results obtained with cold metal. Had there been a crack in the bush which was said to have been cast at 1,300 deg. C. he would certainly have said that it was a hot crack. In spite of the fact that Mr. Gibbs had checked his pyrometer, however, he felt inclined to challenge the statement that the casting was poured at 1,300 deg. C. The appearance of the top of the runner led him to suggest that, because he would have expected to have seen the tin content exuding from the top.

Mr. H. A. Carrell did not think the trouble was due to the pouring temperature. His suggested cure for the trouble was to have a small runner on the outside of the flange of the bush, with a riser of square section.

Effect of Stewing and Moulding Conditions.

MR. FENN asked whether Mr. Gibbs had watched the pots in the fire, because he thought a good deal of trouble was due, not to the pouring temperature, but to the length of time during which the metal was allowed to stew in the furnace. No matter what the pouring temperature might be, if the metal were left to stew in the furnace for too long a period one would rarely obtain a good casting.

MR. W. B. LAKE, referring to Mr. Gibbs' point that the casting poured at the highest temperature was sound, suggested that he should have a larger moulding box, mould all three castings in the one box, and cast them all at the same time. If they were cast at the high temperature they should all be sound, according to Mr. Gibbs' theory.

MR. CARRELL said he had had test bars cast in that way, but had found a difference of 4 tons in the results obtained with them.

Effect of the Mould Emphasised.

MR. GIBBS produced another sample of a bush, the cracked section of which was cut out, showing that, although the crack looked rather bad from the outside, it penetrated only a small distance into the casting. It seemed to him that his trouble was due to gases, purely and simply, because the higher the pouring temperature, the longer did the casting remain liquid, so giving the gas a better chance of getting away. At the same time, he pointed out that he made bushes (which were larger than those of which he had been speaking) with dry sand cores, so that the skin was not chilled, and these were quite successful, no matter whether they were poured at the higher or the lower temperature. It might be suggested that the solution of the problem was to core out all the work, but that meant more labour. His problem was to produce sound bushes, pouring at the correct temperature, by the methods used at present. Replying to Mr. Gardom, he said the question of the arsenic content had been put to him before, but he did not think that would cause a great deal of trouble. He assured Mr. Hand and Mr. Fenn that the metal was not allowed to stew in the furnace; it was in the furnace very little more than an hour, and there was no such thing as the metal boiling. With regard to Mr. Carrell's suggestion, to use a small runner and a heavy riser, he pointed out that this would involve extra fettling costs, and more time would be required for cutting off the risers. M. Ronceray's method of slow pouring, with a pencil runner on the top, had been tried, but it had not been so successful as he would have liked it to have been. The castings produced in that way were not cracked, but several flaws were seen when the castings were turned. He did not think there was much wrong with the pyrometers used: they were checked, one against the other. He had not tried pouring at temperatures intermediate between 1,300 and 1,200 deg. C., but it was probable that sound castings would be produced by pouring at 1,280 deg. C., as Mr. Pierce had suggested. It must be remembered that the castings were poured in green sand moulds. Gases were generated when the metal came into contact with the green sand, and, due to the low pouring temperature, probably those gases were occluded in the metal.

MR. H. O. SLATER asked when the zinc and tin were added.

MR. GIBBS replied that the pot was withdrawn from the furnace, the slag skimmed off, then the zinc was added and thoroughly stirred in, and then the tin was added. It was not beneficial to add the tin earlier, because tin oxide was likely to be produced.

Running Conditions.

MR. W. B. LAKE asked if Mr. Gibbs had tried using two runners.

MR. GIBBS said he had, and had also used a spray runner, but the results obtained were, if anything, a little worse than previously.

After Mr. Gibbs had illustrated how the spray runner he had used had run the casting,

MR. LAKE suggested that the two ends of the spray runner should be further apart. (The casting being circular in section, the suggestion was that the two ends of the runner should each join the circumference of the casting at points opposite each other, so that the distance between the two ends should be equal to the diameter of the casting, and better distribution of metal would be obtained). He made the suggestion because he believed the crack which had been produced was a contraction crack, caused through one side of the casting setting before the other.

MR. H. O. SLATER suggested that both the runners should join the casting at the same tangent, so that all the metal would enter the casting and flow round it in the one direction, instead of there being two streams of metal flowing in opposite directions and meeting each other. The theory of the equal distribution of metal he considered to be one of the best theories that a moulder could work upon. He had found his suggested method to be beneficial in malleable iron work.

MR. GIBBS replied that that did not dispose of the fact that sound castings were obtained with dry sand cores.

THE POURING OF STERLING SILVER INGOTS.

MR. G. C. PIERCE introduced another problem, which was that of pouring sound sterling silver ingots from which wire was drawn. From a bar 1⅝-in. in diameter, and about 32-in. long, if it were sound, something like 4,800 yards of 0.02 wire was obtained. He had tried various methods of obtaining sound ingots, but had found it to be more difficult than might be imagined, and he had come to the conclusion that silver was about the worst metal one could encounter in the foundry. Sterling silver consisted of 0.925 silver and 0.075 copper. The difficulty was that the ingots were supposed to be cast in a steel or iron chill. He had not a mild steel chill, but had a number of cast iron chills which were used for the purpose. In the first place he had tackled the job by cleaning one of the chills thoroughly, giving it a very fine coating of tallow, warming the chill, and pouring the melted silver directly into it. The result was ignominous failure. He had since tried various other coatings for the chill, and had not yet succeeded in getting a sound bar. Then he had tried casting in sand. By that means a bar was produced which had a very nice appearance externally, but when one tried to draw it one found that, before the diameter had been reduced by ¼ in., a number of longitudinal cracks were present, and the bar was useless for the purpose of wire drawing. He had tried casting in sand moulds faced with a plumbago wash, pouring from the top, both vertically and at an angle of about 20 degrees, with a small runner, as well as pouring into the bottom of the bars. He had also poured with a cup at the top, the cup having a small hole, so that the metal would not touch the sides of the mould or chill during pouring—this had been done both with chill and sand moulds. The best bar he had obtained so far was that which was poured in the chill mould, dry plumbago being rubbed well into the chill. There was not the slightest doubt that the correct procedure was necessary in the melting of silver, but he was not at all sure that he had found the correct procedure. The metal was melted in a plumbago crucible in a pot fire, care being taken to see that it was not over-heated. He had tried various fluxes and various protectors, starting with charcoal, the heat being watched in order to ensure that there was no more superheat than was required for pouring, and care being taken also to see that the metal did not stew in the fire. Sal-ammoniac, borax and a patent flux had been tried, but still a perfect bar had not been obtained.

Mr. Pierce exhibited part of a bar which had been turned in a lathe in order to see how far the cracks had penetrated. When it had been turned down to the point at which it was thought the cracks had disappeared he was still dissatisfied, and had had the bar broken. At one end there was a fairly good fracture, but at the other end there were holes like those of a sponge, although, when in the lathe, the bar had a fairly good appearance.

Steel Moulds Unsatisfactory.

A SPEAKER suggested pouring into a steel tube, with a plug at the bottom, and with a good head

at the top in order to prevent air being drawn in with the silver. Then, when the head had been filled, the plug could be withdrawn, and the metal would be allowed to run out of the tube.

Mr. Pierce replied that the action of the silver upon the chill mould was surprising. The silver appeared to eat right into the iron, and no other metal of which he had had experience had done that; even phosphor bronze did not eat into the iron as the silver did, and, therefore, he would be sceptical about running a quantity through a steel tube. In order to overcome the difficulty of entrapping air, the bar was poured from the bottom and the metal flowed through the mould until quite a large head—for the size of the bar—was made at the top.

Mr. Fenn asked if Mr. Pierce had tried a whitening solution as a dressing.

Mr. Pierce replied that he had tried French chalk, with just sufficient claywash in it to make it adhere to the mould. That gave a very good coating.

Mr. Fenn said he had found that a solution of soda and whitening made a good dressing.

Mr. G. Hand said that the proposition, of course, was that silver entrapped more gas than any other metal, and the difficulty was to get rid of that gas.

The Branch-President asked what remedy Mr. Hand would suggest.

Mr. Hand said that he himself could not suggest a remedy, but the silversmiths got over the difficulty quite easily.

Mr. Fenn, having ascertained from Mr. Pierce that the diameter of the bar was 1⅛ in., that the chill was octagon-shaped, and that its length was such as to give an 11-in. bar (without the head), suggested using a chill 18 in. long, tilting it at an angle, and pouring gradually, so that the metal would run down.

Mr. Pierce said he had tried that.

Old Chills Preferable.

The Branch-President said he gathered that only two castings were made in that way, and that was a small number to make with one chill. One often had a lot of trouble with chills, which sometimes did not give good results until quite a lot of castings had been made.

Mr. H. O. Slater said he had found that certain ingots with which he had been concerned were absolutely unsatisfactory until they were annealed. They were made in a cast-iron chill, coated with paraffin, dried off, and sprinkled with plumbago and polished.

Mr. Pierce said that that again raised the question of making moulds out of unsuitable iron.

Mr. Slater replied that it did not altogether. He had tried many irons, including malleable iron and ordinary cast iron. The ingots were annealed at a fairly high temperature.

Finding a De-oxidising Agent.

Mr. A. F. Gibbs pointed out that the gas occluded in the casting might be either an oxidising or a reducing gas, and suggested an experiment with a small quantity of silver, using a powerful de-oxidiser. Some experiments were carried out on cartridge cases during the war, and, in order to get the brass into a condition suitable for rolling, de-oxidising had been tried, but it was found to be detrimental. Reducing agents were then used, with success.

Mr. Pierce asked Mr. Gibbs if he could suggest a de-oxidiser for use in silver which would not interfere with the analysis, because it was important that the analysis should not be materially altered.

Mr. Gibbs said he was suggesting merely an experiment with a small quantity of silver, in order to determine whether or not de-oxidising was necessary.

Mr. Pierce replied that, in his opinion, the appearance of the bar suggested that it did want de-oxidising.

Mr. Slater was of opinon that many of these troubles were not metallurgical but practical moulding troubles.

Mr. Pierce asked what he would suggest for a sand mould thoroughly dry.

Mr. Slater said that a cup-shaped head might be an advantage. The best method he had found for making test bars was to run from the bottom, and to have a bulb-shaped head at the top with a small hole in it, so that it would give the necessary pressure and would, at the same time, allow the air to escape.

Mr. Pierce said he understood that the silver bars with which he was concerned were always poured in chill moulds, probably because the bars were used for wire drawing. The use of sand moulds was merely an expedient, because he had wanted to obtain a good bar to enable the wire drawers to carry on until he had found out the correct procedure for producing the bars. He believed that care was taken usually, when pouring in a mould, to ensure that the metal dropped right down to the bottom of the mould without once touching the sides. He had tried that, but had found still that there were gas holes one-tenth in. deep which could be seen with the naked eye. He added that he had to produce a bar which was only a few ounces short of the weight of the metal sent, so that there was not a great deal of surplus.

A Vented Chill Suggested.

Mr. Slater suggested using a chill with a number of small holes or vents up each side, to allow the air to escape.

Mr. Pierce said he would try to conduct an experiment on those lines. He felt convinced, however, that his trouble was a metallurgical one.

Mr. Carrell said he had worked in a gold and silver shop, and there had been no trouble, so far as he knew.

Mr. Pierce asked how the bars were poured.

Mr. Carrell replied that they were made in moulds, quite dry, a fairly good runner being used.

Mr. Pierce said that presumably that would lead Mr. Carrell to agree that the trouble experienced in the present case was metallurgical.

Mr. Carrell agreed that it looked like it.

Mr. C. H. Kain suggested that the trouble might be overcome by melting in a strongly reducing atmosphere.

Mr Pierce replied that he had been melting 14-lb. bars in a 20-lb. crucible, which was considerably below the entrance to the flue.

Contracts Open.

Antwerp, June 20.—(Contract 576) 32 full portal travelling electric cranes for the Port of Antwerp, for the Municipality of Antwerp. The Department of Overseas Trade, 35, Old Queen Street, S.W.1. (Ref. A.X. 4,653.)

Johannesburg, June 23.—(No. 1,000) 3½ tons brass piping, 6 tons brass sheets and 6¼ tons copper sheets, for the South African Railways and Harbours. The Department of Overseas Trade, 35, Old Queen Street, S.W.1. (Ref. A.X. 4,667.)

Kingsley, Cheadle, June 10.—1,960 yards of 3-in. and 2-in. cast-iron mains, and 3-in. and 2-in. sluice valves, etc., for the Cheadle Rural District Council. Messrs. Willcox & Raikes, the engineers, 63, Temple Row, Birmingham. (Fee £2 2s., returnable.)

London, S.W.1, May 31-June 1.—(1) 500 steel axles for carriages and wagons, and (2) 1,800 tons pig-iron (Scotch No. 3), for the Madras and Southern Mahratta Railway Company, Limited, 25, Buckingham Palace Road, Westminster, S.W.1. (Fee, £1 1s. each, non-returnable.) (Tenders due on May 31 for (1) and June 1 for (2).)

Manchester, May 30.—(B56) Low-pressure valves for circulating-water system; (B57) two electrically-driven and one steam turbo-driven boiler feed pumps, for the Electricity Committee. Mr. H. C. Lamb, chief engineer and manager, Electricity Department, Town Hall, Manchester. (Fee £1 1s. for each section, returnable.)

Melbourne, June 28.—Jacks, switchboard instruments and number plates, for the Deputy Director of Posts and Telegraphs, Melbourne. The Department of Overseas Trade, 35, Old Queen Street, S.W.1. (Ref. B.X. 3,474.)

Rochdale, June 4.—Iron pipes and special castings, for the Waterworks Committee, during the period ending March 31, 1928. Mr. W. H. Hickson, town clerk, Town Hall, Rochdale.

Sheffield, June 11.—A weighbridge, for the Tramways, etc., Committee. Mr. A. R. Fearnley, general manager, Division Street, Sheffield.

Trimdon, Durham,—Iron and steel castings, etc., from July 1 to December 31, 1927, for Walter Scott, Limited. Messrs. Walter Scott, Limited, Trimdon Grange Colliery, Trimdon Station, S.O., Co. Durham.

Manganese and Ferro-Manganese.*

By Sir Robert Hadfield, Bt. D.Sc., D.Met.

(A) THE METAL MANGANESE AND ITS PROPERTIES.

One object of this Paper is to give a general historical account of the metal manganese and the uses to which it has been applied. Another object is to show the interesting way in which the production and use of ferro-manganese was brought about, and the important part played in its development by our country. In addition, there is given some account of the present world position as regards the resources of manganese ores, more particularly from the British point of view. The properties of the metal manganese itself are also referred to so far as they have been ascertained.

After a brief historical survey of the subject the author remarks that, so far as he has been able to trace, nothing of practical importance as regards the employment of manganese in the manufacture of steel happened until Heath, about the year 1839, introduced the use of carburet of manganese into the manufacture of crucible steel. Heath in his patent declared that his invention consisted in the use of "carburet of manganese" in any process whereby iron is converted into cast steel. Had he seen in his own day the Bessemer process in operation, he could not have said more; he well knew the effect produced by manganese on steel, and therefore claimed its employment in any process whereby iron is converted into cast steel. David Mushet went so far as producing what to-day would be called a species of ferro-manganese. His son, Robert Mushet, made practical use of spiegeleisen as applied to the Bessemer process; Prieger, of Prussia, did useful work, and Bessemer himself took a most active interest in encouraging the production of this metal by Henderson, in the form of ferro-manganese; finally Pourcel, in France, solved the problem by producing, on an industrial scale, the valuable alloy now known as ferro-manganese, of which the world at present uses between 500,000 and 800,000 tons annually. These figures have been arrived at in the following manner, and must necessarily be regarded as approximate only:—

	Tons.
(1) The steel output of the world for 1925 was	87,000,000
(2) Assuming the manganese percentage averages 0.75 per cent., this output of steel requires a tonnage of manganese amounting to	625,000
(3) If ferro-manganese containing 80 per cent. is used, this steel output requires a tonnage of ferro-manganese amounting to	780,000
If 0.75 per cent. manganese is considered too high a percentage, then—	
(4) Assuming 0.50 per cent., the world output of steel requires a tonnage of manganese amounting to	400,000
(5) On the assumption of 0.50 per cent. of manganese in the steel, the tonnage of 80 per cent. ferro-manganese required would amount to about ...	500,000

Between the discovery of manganese and the complete development of its use over a century passed, and to no one individual can the sole credit be given. Modern metallurgical developments naturally have proceeded much more rapidly, the environment being more suitable—in fact, the rate at which they now crowd fast one after the other is most remarkable, and, indeed, a sign of the times.

Ores of Manganese and Their Distribution.

The affinity of manganese for oxygen is very great, and the metal is, consequently, nowhere found in the free or uncombined state. Its ores, of which, metallurgically, the oxides are the most important, are very widely distributed. They are even found in the form of nodules thickly strewn over the ocean beds for hundreds of miles and often at great depths, as well as at the bottoms of many lakes. Manganese ores are invariably associated with iron ores. At the same time, iron is not found in any important quantity with the commercially workable deposits of manganese, which also are confined to comparatively few countries. The commonest varieties are psilomelane and pyrolusite. This latter is the "black oxide of manganese," a dioxide containing, when pure, 63.2 per cent. manganese. The richest oxide (MnO), containing 77.5 per cent. manganese, occurs as the mineral manganosite. The great bulk of the manganese ores employed commercially come from Southern and Central India, from the Gold Coast, and from Georgia and Brazil. The invariable association of iron with manganese complicates the commercial classification of manganese ores, which range in quality from the richest in manganese, containing the smallest percentage of iron, to the lowest grade ores, which are virtually iron ores with not less than 5 per cent. manganese. The most convenient classification is that proposed by Fermor, although, unfortunately, it has not been generally adopted. It is as follows:—

	Manganese.	Iron.
	Per cent.	Per cent.
Manganese ores	40 to 63	0 to 10
Ferruginous manganese ores..	25 „ 50	10 „ 30
Manganiferous iron ores ..	5 „ 30	30 „ 56
Iron ores	0 „ 5	45 „ 70

In the United Kingdom manganese ores occur in North Wales, Cornwall, Devonshire, Derbyshire, Worcestershire, and Cumberland. During the earlier part of the present century the annual output was in some years nearly 23,000 tons. Production has, however, fallen off very considerably, although, during the scarcity of supplies in the Great War, it rose again, and in 1918 attained 17,465 tons. In 1924 the world consumption of manganese ores was 1,450,000 tons, that of the United Kingdom alone having amounted to 331,527 tons, from which it is obvious that the home supply is quite insignificant; hence the importance of securing an adequate source of supply to our country. It should, however, be noted that the figures relating to manganese ore production and consumption vary considerably, according to the various authorities, and it is by no means always clear what grades are included or excluded in the official statistics published from time to time. The information available up to the time of the preparation of this Paper is embodied in Table I.

An important monograph * on manganese ore, by Mr. Datico Zereteli, was published in 1925, from which the following particulars are quoted. It is satisfactory to note that, even if the manganese resources of the United Kingdom are on so small a scale, the resources of the Empire rank above those of any other country. Thus while, in 1924, Brazil produced 200,000 tons, and Georgia in Russia, which before the war was the principal producer, contributed 480,795 tons, India produced no less than 639,210 tons, and the Gold Coast 255,647 tons. Manganese ores are also found in other parts of the British Empire, such as South Africa, East Africa, Canada, and Australia.

The chief European supplies are derived from the Georgian deposits, of which those of Tchiaturi are the most extensive, being estimated, according to Zereteli, to contain nearly 220,000,000 tons, 73,000,000 having already been extracted. Further very extensive deposits occur in other parts of the Union of Socialist Soviet Republics, notably in the Nikopol and Gaisinsk districts, in the Urals, in Siberia, and in North Caucasia. Small amounts of rich (60 per cent. manganese) ores are found in Spain, Italy, and Sweden, and lower grade ores are found in France, Belgium, Germany, Greece, and Turkey.

* From a Paper on "The Metal Manganese and Its Properties: Also Ores and the Production of Ferro-Manganese and Its History" read before the Annual Meeting of the Iron and Steel Institute.

* "Manganese Ore with Special Reference to Georgian Ore." Dryden Press. London, 1925.

XUM

Although high-grade ores occur in the United States, most of the manganese ore deposits in that country are low-grade, or consist of manganiferous iron ore only. During the war, however, these native resources were extensively exploited, production in 1918 having attained to no less than 305,869 tons. In that year the production of ferruginous manganese ore (10 to 35 per cent. manganese) and of manganiferous iron ore (5 to 10 per cent. manganese) rose to 916,163 and 254,299 tons respectively, the production of ferro-manganese in the United States in that year reaching 333,027 tons. The known reserves are, however, small, and the output has fallen greatly; Montana, which in 1918 produced 199,932 tons, produced only 21,916 tons in 1924. Incidentally, it may be mentioned that the total iron ore mined in the United States in 1925 amounted to approximately 62 million tons, of an estimated value of £32,000,000. Out of this total, 37 million tons came from Minnesota and 15 million tons from Michigan. The steel produced from this ore and other materials amounted to somewhat over 45 million tons, and assuming that it contained an average of 0.75 per cent. manganese, the total quantity of manganese ore required, allowing for 20 per cent. loss in smelting, would be over 850,000 tons, whereas the United States itself in 1925 mined only 76,000 tons of high-grade and 267,000 tons of low-grade manganese ore.

It must not be forgotten that although the U.S.A. increased its steel production from about 31 million tons in 1913 to over 45 million tons in 1925, the production of steel outside that country is lower to-day than in 1913. The production of the main countries in Europe, including the United Kingdom, Germany, Luxemburg, France, Belgium, and Russia, was 38 million tons in 1913, whereas in 1925 this had dropped to 33 million tons. The chief loss is due to the falling off of about 3 million tons as regards Germany; France shows an increase of about 3 million tons. At any rate, as regards Europe, at the present time there is really less demand for manganese ores than before the Great War.

Mr. P. M. Tyler* has shown that for a probable average steel output in the world of 100 million tons annually for the next few years, about 750,000 tons of ferro-manganese per annum will be required, allowing, say, 16 to 18 lbs. of 80 per cent. ferro-manganese per ton of steel produced (or about 0.60 per cent. manganese in the final product). Making the necessary allowance for metallurgical losses, which may be reduced by improved electric processes, the production of this amount of ferro-manganese would require about 1,600,000 tons of 50 per cent. ore, with an additional requirement of about 150,000 tons for all other purposes. These calculations are apparently based on a 25 per cent. loss in smelting the ore. The pre-war production was about 2,200,000 tons of manganese ore, of which Russia supplied 1,200,000 tons, the remainder coming chiefly from India and Brazil.

With regard to the supply of manganese ore from the Gold Coast, the African Manganese Company, Limited, exhibited samples from the ore to the finished product at the British Empire Exhibition held at Wembley in 1924 and 1925. The developments made by this Company have been most remarkable, and manganese ore now forms one of the principal exports from the Gold Coast. The deposits were discovered by the Geological Survey in 1914, but were not developed until 1916. The largest deposit occurs at Insuta-Dagwin, Gold Coast, where it forms the major portion of a high ridge, extending for about 2 miles by the side of the Sekondi-Kumasi Railway at a distance of 36 to 38 miles from the port of Sekondi. This huge deposit consists of massive ore and of "detrital" ore, the latter being composed of manganese oxide in grains and small to large nodules in a red clayey soil. The ore now being produced is of high grade, and is specially suitable for the manufacture of ferro-manganese. Much of it is of the best quality, and is used in the chemical industry. The analysis of the average ore is:—Manganese, 50 to 53; iron, 2 to 4; silica, 3 to 7; phosphorus, 0.1 to 0.12 per cent.

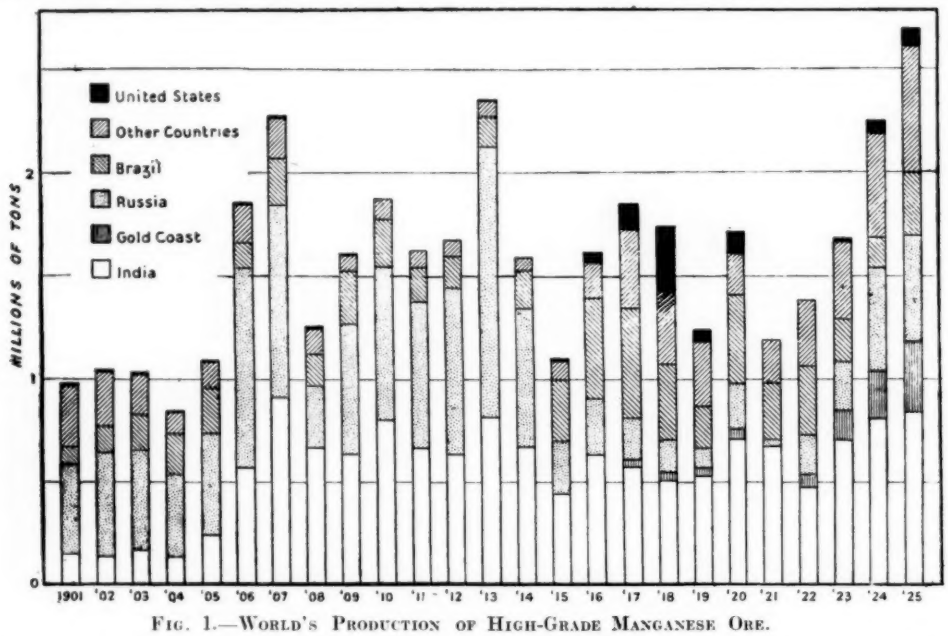


FIG. 1.—WORLD'S PRODUCTION OF HIGH-GRADE MANGANESE ORE.

The following are the shipments of manganese ore from West Africa for the years 1916 to 1925. The considerable fall in 1921 was due to the shortage of ocean transport:—In 1916, 4,300 tons; in 1920, 41,000 tons; in 1921, 7,000 tons; in 1923, 117,900 tons; in 1924, 255,400 tons; in 1925, 357,200 tons. The total exports up to March 31, 1925, were approximately 660,000 tons, having a value of about £1,237,000.

The author understands that manganese ore (42 per cent. manganese) has recently been found in the Belgian Congo.

In a recent communication from Johannesburg it was stated that the Union Manganese Company of Johannesburg had signed an important contract with two large American steel companies, under which the latter obtain the right to work the manganese deposits near Postmasburg on a royalty basis. The deposits are said to extend for forty miles. Under the scheme it is stated that a large company will be formed in America, and that a railway is about to be built connecting the fields with the main line. The latest reports respecting these deposits state that they are of high grade and contain as much as 1,000,000,000 tons of procurable ore. Should this estimate be found to be even approximately correct, the apprehensions so freely expressed in some quarters as to a possible

* "The Iron Age," August 29, 1926.

future shortage of manganese ore will prove groundless. The American interests referred to are reported to have placed in the hands of the Government of South Africa a sum of £250,000 for the contemplated railway, and to have allocated no less than £2,000,000 for the purpose of developing the enterprise.

The Indian ore deposits are in the Central Provinces, Madras and Bombay provinces, Mysore, Bengal, and Lower Burmah. The Central Provinces Manganese Ore Company, Limited, is the largest producer of manganese ore in India, and owns twenty separate mines in the Central Provinces, which are estimated to contain upwards of 20,000,000 tons of high-grade ore.

It is interesting to note that ferro-manganese of 80 per cent. grade has been recently made quite successfully by the Monterrey Iron & Steel Company of Mexico. All the raw materials used in its manufacture were obtained in Mexico, the manganese ore being mined in the States of Durango, San Luis Potosi, and Chihuahua.

In Japan there are manganese ore deposits, but the highest output was about 57,000 tons in 1918.

Manganese ores are also found in Cuba, Costa Rica, the Argentine, and in Chile, while deposits occur in China, in the Philippine Islands, and in Portuguese India.

The question of shortage of manganese supplies, whilst not immediately a serious one, may prove to be so in the not very far distant future. There is no doubt that from the ferro-metallurgist's point of view the metal manganese ranks next in importance to the metal iron. The ordinary steel of commerce cannot be made satisfactorily unless containing from about 0.40 per cent. to 1.00 per cent. of manganese—that is, apart from the oxidised portion, this percentage should remain in the final steel product. Thus every million tons of such steel requires from about 9,000 to 12,000 tons of ferro-manganese containing 80 per cent. of the metal manganese. Seeing that America alone is now producing at the rate of over 45 million tons of steel per annum, whilst it is true much of this is produced from remelted scrap, it will be seen that the demand for the metal manganese must be very large.

In an article by Mr. Josiah Edward Spurr,* that author mentions the peculiar but important fact that Nature has distributed manganese ores in quite different areas from those in which she has segregated iron. In the Lake Superior iron-ore region, for instance, there are no manganese deposits of importance, and this applies to the second greatest steel-producing district in the world—Alsace-Lorraine. In the opposite direction there is no steel industry in Brazil or in the Russian Caucasus, or on the Gold Coast. India is the only country rich in manganese where a steel industry has been established.

In this same article Mr. Spurr reproduces an interesting diagram of the world's production of manganese ore from 1901 to 1920, which appeared in the Report of a Joint Committee of the Mining and Metallurgical Society of America and the American Institute of Mining and Metallurgical Engineers. This diagram is shown in Fig. 1, to which the author has added the latest information available, that is, up to the year 1925. The figures for the years 1901 to 1920 are similar to those obtained by our own Imperial Mineral Resources

TABLE 1.—*World's Production of High-grade Manganese Ores. (Thousands of tons.)*

Country.	1921.	1922.	1923.	1924.	1925.
India	679	474	695	803	710
Gold Coast ..	7	66	140	233	339
Russia ..	28	193	237	492	513
Brazil ..	271	335	232	157	307
United States	14	13	33	57	76
Other countries	200	300	350	500	500
Totals ..	1,199	1,381	1,687	2,242	2,445

Bureau, who have kindly provided the author with the information for the years 1921 to 1925. Table I gives the production figures for India, Gold Coast, Russia, Brazil, and the United States for those years.

* "Steel-making Minerals," "Foreign Affairs." July, 1926 (American monthly).

In addition, there is the tonnage of low-grade ores to be added, namely, about 250,000 tons in 1925. The grand total of all grades of manganese ores in 1925 amounted therefore to about 2,700,000 tons, of which the British Empire produced 1,190,000, or 44 per cent.

(To be continued.)

Institution of Civil Engineers.

Election of Officers.

At the annual general meeting of the Institution of Civil Engineers, held on May 10, the result of the ballot for the election of officers was declared as follows :—

President: Mr. E. F. Crosbie Trench, C.B.E., M.A., B.A.I. (London).

Vice-Presidents: Sir Archibald Denny, Bart.; Sir Brodie Haldane Henderson, K.C.M.G., C.B.; Sir J. F. Cleverton Snell, G.B.E., and Mr. G. W. Humphreys, C.B.E. (London).

Other Members of Council: Messrs. R. D. Thain Alexander, D.S.O., O.B.E. (India); H. Newmarch Allot; T. H. Bailey; W. J. Eames Binnie, M.A.; Sir Dugald Clerk, K.B.E., D.Sc.; Col. R. E. Bell Crompton, C.B.; Professor W. E. Dalby, M.A., B.Sc.; Mr. S. Bryan Donkin; Sir Alexander Gibb, G.B.E., C.B.; Mr. W. Wylie Grierson, C.B.E.; Sir Robert A. Hadfield, Bart., D.Sc., D.Met.; Mr. E. Prescot Hill; Sir Clement D. Maggs Hindley, M.A. (India); Mr T. W. Keele (Australia); Sir C. R. S. Kirkpatrick; Mr. D. E. Lloyd-Davies (South Africa); Sir Murdoch MacDonald, K.C.M.G., C.B., M.P.; Sir H. P. Maybury, K.C.M.G., C.B., M.P.; Sir R. A. S. Redmayne, K.C.B., M.Sc.; Mr. H. A. Reed; Sir Hugh Reid, Bart., C.B.E., LL.D.; Professor R. J. Scott (New Zealand); Mr. W. A. Porter Tait, B.Sc.; Mr. H. Hague Vaughan (Canada); Mr. J. D. Watson; Sir A. Fernandez Yarrow, Bart.

This Council will take office on the first Tuesday in November, 1927.

Iron and Steel Production.

The National Federation of Iron and Steel Manufacturers, in their Statistical Bulletin for March, 1927, state that production of steel ingots and castings in March amounted to 949,600 tons and was the highest since the war, exceeding the previous best (September, 1920) by some 65,000 tons. The number of blast furnaces in operation increased by 12 during the month to 178, and the production of pig-iron amounted to 671,800 tons compared with 571,100 last February and 568,500 tons in March, 1926. The production of pig-iron in the first quarter of 1927 (1,677,500 tons) exceeded that in 1926 by 73,500 tons, and that of steel (2,507,100 tons) by 378,800 tons.

The number of furnaces in blast at the end of April was 189, a net increase of 11 since the beginning of the month: at the end of April last year 147 furnaces were in blast.

The production of pig-iron in April amounted to 680,000 tons compared with 671,800 tons in March, and 539,100 tons in April, 1926. The production included 237,800 tons of hematite, 207,300 tons of basic, 182,500 tons of foundry and 22,600 tons of forge iron.

The production of steel ingots and castings in April amounted to 850,100 tons compared with 949,600 tons in March, the decline being due to the Easter holidays. The production in April, 1926, amounted to 661,000 tons.

Determination of Sulphur in Coal and Coke.—According to a Paper presented before the Richmond, Va., meeting of the Division of Gas and Fuel Chemistry of the American Chemical Society, by W. A. Selvig and A. C. Fieldner (U.S. Bureau of Mines), sixteen samples of coal and coke, ranging in sulphur content from about 0.5 to 17.0 per cent., were analysed in five different laboratories by the Eschka, bomb-washing, and sodium-peroxide fusion methods. The best average checks between duplicate determinations were obtained with the sodium-peroxide fusion method. In general, the laboratories were able to obtain results with the bomb-washing and sodium-peroxide fusion methods which checked those of the Eschka method sufficiently close to show that these methods may be used alternately with the Eschka method, which has for long been the recognised standard for sulphur determination in coal and coke.

The Combustibility of Coke.*

By W. Diamond.

Recovery Coke Ovens.

There are to-day several different types of ovens on the market. Each type has its own constructional peculiarities, which—it is claimed—make the said oven produce more and better coke from inferior material; as a matter of fact, the makers of all types make that claim.

The oven is a rectangular chamber, having a capacity of from 8 to 12 tons of coal, varying in height, width and length. Each side is constructed of silica or ganister lumps forming either horizontal flues or vertical flues; the sole, or floor, of the oven also has flues running through the length or divided into halves, as in the vertical flued ovens. At each end of the oven is fitted a detachable door; on the machine side, or ram discharger side, the door may be by special mechanism taken straight away on the bench or discharging side. The door is lifted and swung away whilst the oven is being discharged. The arch of the oven is fitted with three port holes, or discharging holes, in equal distance. These are for the purpose of providing openings into each oven, through which coal can be poured into the ovens. There is also a mechanism which operates a long arm about 55 ft. long for the purpose of levelling the coal within the oven. The ram side door has a small door fitted to it, through which the levelling arm enters the oven.

There is also a pipe fitted to each oven through the crown, and coupled with suitable valves to a hydraulic main. The pipe is for the purpose of collecting and conducting the gas evolved from the coke, when the side walls and sole are heated by waste gas, *i.e.*, after the chemicals have been abstracted.

On the bench side, or discharge side, there are to-day several different devices to quench, convey and screen the coke. Some plants have metal tray conveyors, others have rubber belt conveyors to take the coke to the screening plant. At the most recent plants the coke is taken to a quenching tower, where the coke is simply douched with tons of water; the surplus water is collected and pumped into the tower tank for use again. At some places a structure of pipes in the shape of a horseshoe, all of them being perforated, is coupled to a water supply; all the hot coke, being discharged, passes through and is more or less quenched.

There is a necessary piece of plant—namely, the ram—for pushing the coke out of the oven when the coal has been sufficiently carbonised. This point is easily determined. As there is generally the same man employed for this purpose, there is little probability of a mistake in pushing out coke insufficiently carbonised.

It will be observed that the coal is heated from two sides by the side walls forming the heating medium, and these walls are heated as nearly as possible at the same rate and degree of heat. In this way, when the heat has reached the centre of the charge of coal, it is met by the heat from the opposite side, thus completing the operation, and, at the same time, causing the coke to form pieces in size exactly half the width of the oven, which is generally 9 ins. The measurements in the other directions differ because of the fracture caused by cooling, quenching and handling.

The coal from which the coke is produced can be obtained from certain seams in a limited area. In priority, they are Durham, Yorkshire, Scotland around Glasgow, parts of Derbyshire, Northumberland and Cumberland.

Coke may have the same chemical composition when made from seams of coal mined in different counties, but the composition of the coal used in the manufacture differs very greatly, and acts very differently when carbonised. In Yorkshire, Parkgate and Silkstone coal produce a remarkably good metallurgical coke; whilst in Durham, Busty and Brockwell coal produce a better coke, differing very slightly in composition with the exception of sulphur content. (The Durham coke contains about 0.7 per cent. sulphur, whilst Yorkshire coke may contain 1.5 per cent.)

If only the elemental carbon is required for furnace purposes without considering whether the coke would meet other demands made upon it, then it would appear that the lowest grade coke would answer the purpose of smelting; but that is insufficient for coke for furnace or foundry purposes. A coke must have a good cellular structure, a uniform ash content, say 9.0 per cent., a moisture content of not higher than 4 per cent., sulphur under 1.0 per cent., which leaves a carbon content by deduction of about 86 per cent. in the wet basis. It is necessary to obtain a consistent composition—higher or lower if required—but whatever the composition may be, it must be constant. This is only an ideal which blast furnace and foundry managers never or rarely obtain. Where modern coal-cleaning plants, either of the Baum type or the dry-coal separation type, are installed, and the resultant coal used for carbonising, coke of consistent composition is obtained. This is becoming daily more urgent in view of the greater commercial competition.

Structural Strength of Coke.

Certain coke does not hold the load either in a furnace or cupola. Very often the cause has been found to be due to one of many other possible causes, either irregular supply of air through the tuyères causing side burning, and so permitting the load to fall through before the opposite side has burned through, or overloading. There are many other causes.

There has been much work done, both in the works and laboratory, carried out to ascertain the nature of the burning of the coal under furnace conditions. When coke is used in either furnace or cupola it is required to act in two different capacities. In the furnace, coke acts both as a heating medium and as a means of separating the iron from the ore by chemical reduction. In the cupola, coke acts simply as a substance by which the scrap iron or pig-iron may be melted and heated to a required temperature for casting. In the case of blast furnaces it has been stated by Howland that at 26 different blast furnaces in America, using the same ore, but different coke, the consumption of coke varied from 1,165 to 707 kilogrammes per 1,000 kilogrammes of pig-iron produced. All makes of cokes do not act in the same manner in the furnaces, particularly in regard to the heat and consequent chemical action.

When coke is burned completely in an open grate there is produced by the combination of carbon with oxygen of the air, first, carbon monoxide, a combustible gas which immediately ignites and is converted into carbon dioxide. Some authorities state the action is a direct one, forming carbon dioxide.

The operation is probably, under all circumstances, a double one, although the double operation would of necessity appear to be simultaneous. If the action be considered to occur in two stages, then it is known by experiment that

$$C + O_2 = CO_2 = 97{,}000 \text{ calories per gramme molecule of } O_2,$$

also that

$$CO_2 + C = 2CO = -38{,}880 \text{ calories.}$$

Thus two molecules of carbon burned to carbon monoxide produce 58,320 calories, which is, of course, the net result after deducting the absorption of heat in the reduction of CO_2 to CO, from the total heat in the full combustion. It appears to be a fact that coke may be said to be more easily combustible simply by having a greater porosity than other coke which is not so porous. By the term porosity one is at the same time admitting it a fact that the coke contains and offers a greater surface upon which the oxygen—blown into the laboratory apparatus, cupola or blast furnace where coke is burning—may react.

The cellular construction of the coke may be firm: that is, the cells may be small and the walls thick and strong, or, on the other hand, the coke

* Paper read before the Middlesbrough Branch of the Institute of British Foundrymen.

cells may be large and the walls thin. Therefore in a cubic volume of coke the surface upon which the oxygen may come into contact would differ very greatly. In the majority of cases this may be observed by inspecting the pieces of coke by the aid of a lens. If this is not sufficient, one could refer to the actual and apparent density of the coke. The relation between these two quantities is accepted as giving the cellular spaces of the coke.

The appearance of the coke produced by the Beehive process is well known, possessing as it does long, strong pieces of metallic appearance. At one time it was considered to be better for foundry and furnace purposes than coke made in the patent retort ovens. It has been said that patent coke could not possibly be so good as the Beehive coke because all the chemicals had been taken out of it. To-day this is known to be a fallacy. Moreover, experiments have proved that the polished surface on the Beehive coke was a detriment. The glaze was entirely, or nearly so, a graphite deposit which requires a higher temperature to combust with oxygen. In the majority of cases the coke was compact and dense, and therefore did not offer much cellular surface, so that it actually contained two disadvantages, surface condition and indifferent porosity.

In order to obtain information that will enable comparisons to be made in the combustibility of coke it is necessary that the conditions of the experiments should be alike. Also it is important to note that results obtained in small scale plants or laboratory tests do not exactly define the actual results which would be obtained in the furnace or cupola. The first condition in the test is to ensure that all the pieces of coke which are to be used in the experiment are of uniform size. It is impossible to get each piece the exact dimension as another; it is sufficient that the pieces of coke should have been screened through and over screens of specific mesh and within narrow limits of dimension. Secondly, the oxygen and air supply to the coke must be at a definite volume, in unit of time and at a consistent pressure.

Having provided these conditions, the type of apparatus in which to carry them out must be chosen. One type is a silica tube, which is heated in an electric furnace; the coke is packed in the tube, through which oxygen or air is passed over the heated coke. The gases evolved may be collected, and analysed for oxygen, CO_2 and CO. The reaction at a specific temperature "T" is adduced from the equation:

$$\frac{CO_2 + CO}{2CO_2 + CO + 2O_2}$$

since a gas containing $X CO_2 . Y CO + Z . O_2$ will give on complete reduction $2X CO . Y CO + 2Z CO$.

Koppers carried out experiments in a salamander. Coke of a definite size is packed into an iron shell and ignited; the air supply is kept consistent by a natural draft. After a given time the coke is cooled and weighed, the loss of weight is supposed to indicate the combustibility, the loss, of course, being compared to other samples tried under the same conditions. This is thought to be a fair and simple test, if carried out with adequate care and supervision, in order to ensure uniform state of conditions. The mechanical conditions which alter during the combustion can also be deduced from a number of such tests. The coke will fall sometimes into a close mass; other times the coke will lodge angle to angle. The first condition will, of course, make the passage of air more difficult, and in the latter the passage of air is free, possibly in some cases too free. It is therefore necessary to make a number of tests, no matter which method is chosen, in order that a reasonable deduction may be made from the results. One pound of coke requires from 6 to 7 lbs. of air for its combustion, so that the air supply must be very carefully controlled.

It is of no advantage to have an easily combustible coke for melting pig-iron and scrap. The most suitable coke will be that which can produce a high temperature for melting purposes; also the sulphur content must be low, from 0.8 to 0.9 per cent., and with an ash content for economical purposes of not more than 8 to 9 per cent. Given a coke of that composition there should be little difficulty in getting good, hot, clean iron.

Some metal, as is well known, must have a low viscosity for making fine castings or for the manufacture of articles which require to stand abrasion; in which case, dense, hard coke is necessary, but it should melt in the ratio of not less than 10 to 1 of coke.

In the blast furnace, of course, the conditions are vastly different. The combustibility controls both the quantity of iron produced per furnace and the quality to a certain extent of the pig-iron.

Having ascertained by experiment the most suitable coke for a given purpose, how can that knowledge be applied? One must ascertain what indications can be found in the cupola to show proper or improper working—that is, in the combustion of coke. If a sample of exit gas is taken from the cupola and analysed, the result is found to be $CO_2 = 16$; $CO = 2$; and nitrogen, 80 per cent.; then good combustion has been obtained and the maximum of heat has been produced somewhere within the cupola, but not necessarily in the proper manner. But if the composition of the exit gas is found to have been, say, 20 per cent. CO, then there has been imperfect combustion.

If the carbon is burned in the proper position in the cupola, then the full value of heat of the 97,000 calories is obtained; but if there is insufficient air, *i.e.*, oxygen, then a very poor heat is produced in the bed and a waste of 39' (approximately) calories. This is one of the causes of poor heat and high combustion of coke, and is most often attributable to poor air supply and high bed coke. In a coke with 88 per cent. carbon, the carbon developing 15,444 B.T.U.—taking it from calories—then supposing we take (224 lbs., coke x air) 1 lb. coke, 88 per cent. carbon x 126 cub. ft. of air to burn to CO. 224 x 126 cub. ft. = vol. of 30,224 cub. ft. for one ton of iron; then 1 lb. coke (88 per cent. carbon) evolves 13,590 B.T.U.; therefore 224 lbs. coke sufficient to melt one ton of iron requires 3,046,400 B.T.U.

This is perfect combustion, but a condition never attained in practice. If a relativity of twice CO_2 to one CO is obtained, then the furnace is working under good conditions. But if the results are reversed—that is, one part CO_2 to two parts CO—then the process is working badly, which is a common expression.

It is not necessary to have a perfectly designed cupola to melt the pig-iron and scrap. The author has seen a so-called cupola made from the shell of a Cornish boiler with sections cut out to form the charging hole, and another to form the opening through which fuel and coke could be placed to form the bed coke. The tuyeres were simply pieces of sheet iron shaped to form a pipe, with one pushed into another and connected to a primitive fan and coupled to the cupola. One would expect such a contrivance to do anything else than give good results, but, as a matter of fact, this cupola was producing molten iron for special purposes and more or less satisfied the owners. The melting of iron—although it can be accomplished in the meanest type of apparatus—is a scientific operation when carried out on the best lines.

The Cupola.

These are designed to give an output of molten iron as may be desired—from 18 in. inside diameter, with a capacity of from ½ ton of metal per hour up to (and perhaps even larger than) 84 in. diameter, with a capacity of 20 to 24 tons of metal per hour. These are average outputs and not to be taken as maximum and minimum quantities. If one has a larger cupola than may be necessary, it can easily be reduced by thickening the lining with ganister lumps; then advantage may be taken of this provision as occasion demands. An important matter is in the relative position of the charging opening, and the tuyere, or, in other words, the distance or depth from the charging opening to the level of the tuyeres. These, again, vary, say, from 9 ft. to 23 ft., and it is reputed that in America there is a plant which has a depth of about 50 ft.

The deeper the cupola is from the charging hole to the tuyeres, the iron and coke, filling up that area, absorb some of the waste heat of the ascending gases; if the coke has been wet or the metal dirty, then the absorption of the waste heat is of considerable value. But for general purposes

the height is determined by the ratio between the internal diameter at the tuyeres and the charging hole, and it ranges from about 1-3 to 1-5. It is known, of course, that the greater the depth of the coke and iron charge within the cupola, the greater will be the resistance to the air, which is delivered to the cupola tuyeres. This is one of the factors which limits the depth.

Volume and Pressure of Blast.

The author has met cases where the cupola charge man has not known what volume of air is being delivered to the cupola, but sometimes could say at what pressure by water gauge the air was being delivered. In order to have proper control of the plant it is necessary that the charge man should know both the pressure and volume of air being delivered. The apparatus for indicating these is not expensive. The gauges give a quick indication as to changing of the charge, or the consolidating by small coke or scrap in the cooler part of the cupola, also as to the capacity and efficiency of the blower. It is understood, of course, that one is quite clear in understanding the difference between the pressure of the air blast and the volume of the air delivered. The former matters very little in the cupola if the volume is delivered. The pressure necessary to deliver the required volume would, of course, be observed when working normally; if, after that, any difference occurred, then one would look round for irregularities. An important and frequently overlooked point is in the resistance caused to the air supply by excessive length of conduit and number of bends and twists; these may put sufficient resistance as to make the capacity of the fan or blower insufficient. It is, of course, understood that the tuyeres are of sufficient capacity and design to permit the air being delivered in regular volume; also that proper provision is made for cleaning the tuyeres of coke and slag obstructions.

In large cupolas it is sometimes said to be necessary that the bed coke should be from 48 in. to 84 in. There is certainly a minimum height, and one may put as much coke into a cupola as one may wish. Experience has shown that it is quite unnecessary to have a greater depth of bed than 24 in. to obtain a quick melt and a regular floor. The conditions of working will bring the required depth to within an inch or so of that figure. If the cupola is in work the iron should come down drop by drop in about seven minutes. If it takes longer time to bring the metal down then the bed depth should be reduced. If the bed coke is too deep, *i.e.*, extravagantly deep, then there is the probability of excessive coke consumption, cold metal and considerable waste, and an indefinite melting zone which sometimes causes the molten iron to become oxidised and useless.

There is a difference in the weight of a cubic foot of coke, when the coke has been made from coal which has been compressed. It may be assumed that it contains more carbon per unit volume than coke made by simply top loading the coke oven charge. If compressed coke is used then it is not necessary to use so deep a bed, nor to use equal measures of coke when loading the cupola as with coke made by other methods. It is, therefore, necessary, if a measure is used in deciding the quantity of fuel, that a few charges of the measure should be weighed and checked from time to time. It is also necessary that the weight of pig and scrap should be consistent and fairly uniform in bulk if one is to obtain satisfactory results. It is a common practice to put into the cupola as scrap, pieces such as the boss of a propeller together with light scrap, and the mixture is expected to be completely fluid at the same moment. If such mixtures are necessary the light scrap should be put in the cupola first, and gradually heavier pieces of pig and scrap metal can follow. Steel melts at a higher temperature, and, consequently, takes a greater quantity, or weight, of coke to attain that temperature, so that the cupola may be blamed for irregular working or consuming an undue proportion of coke.

The ash content of coke plays a very important part in the working of a cupola. Broadly speaking, it may be assumed that for every 100 lbs. of coke consumed in the cupola 10 lbs. of ash will be produced. To this can be added the dirt adhering to scrap, also the rust on light iron, altogether forming a considerable proportion. All this objectionable matter can be removed only by melting and forming a slag; in all probability it will require some flux, such as limestone, to enable the ash to fuse. Whatever proportion this may result in, it has absorbed its quantity of heat; in other words, a definite quantity of coke has been consumed in doing this extraneous work. It is, therefore, advantageous to keep the ash in the coke as low as possible; by so doing, the sulphur content will also be reduced.

Work of the National Physical Laboratory.

In a lecture to the Manchester Section of the Society of Chemical Industry, DR. W. ROSENHAIN (Superintendent of the Metallurgy Department of the Laboratory), said that the National Physical Laboratory was established some 26 years ago as the result of the activities, first of a Committee of the British Association for the Advancement of Science, in which the late Lord Rayleigh was actively concerned, and later of a Government Committee. The Laboratory was begun on a very small scale, under the management of the Royal Society, and with a Government grant of only £7,000 per annum. It was located in the old royal mansion—Bushy House—and the rooms of that old building were adapted to laboratory purposes as well as possible.

The purpose of the Laboratory was to aid the application of science, especially of physics in all its branches, to national and industrial needs. In spite of some early opposition, based upon unfounded fears and jealousies, it rapidly made its usefulness felt, and proved of great importance during the war. Even before the war, however, it had grown so large and important that the financial responsibility was more than the Royal Society could undertake, and the transfer of financial responsibility to the Government was suggested. This was carried out at the end of the war, and the Laboratory was now a part of the Department of Scientific and Industrial Research, although an executive Committee appointed by the Royal Society still retained the scientific management.

The Laboratory now has seven Departments, a scientific staff of over 130, and a total staff of over 500. Similar national laboratories exist in most of the more important countries of the world. The "Reichsanstalt," near Berlin, is one of the best-known, while the United States Bureau of Standards is probably the largest, but the National Physical Laboratory holds a foremost place among such institutions and represents one of the finest organisations for scientific standardisation, testing and research in the world.

The lecturer then gave a brief sketch of some of the more striking activities of the Laboratory, dealing in turn with examples of the three great branches of work. In regard to standardisation, mention was made of the precision gauges used by engineers, of survey tapes, of weights, chemical glass-ware and even of taximeters. Measurement down to the one-millionth of an inch had now become a routine matter. Thermometers, including thousands of clinical thermometers and all types of precision thermometers and pyrometers, were standardised, while in another Division of the Laboratory attention was given to X-rays, and protective measures for those engaged in their use. As a result of this work, more than 100 hospitals had adopted standard methods of protection; rules had been drawn up, and other countries were now following the lead thus given. Electrical meters and instruments of all kinds were standardised in great numbers, and much fundamental work had been done in the more accurate determination of the fundamental electrical units, the ampère and the volt. Means for testing insulating materials under electrical pressures up to one million volts were now being installed.

In the latter part of the lecture the work on metals and alloys was briefly outlined. Recent achievements of the Laboratory related to the production of gas-free metals by simple means, the production of new alloys capable of giving high strength at very high temperatures, and the production of a series of metals—iron, manganese, chromium, silicon, and the rare metal beryllium—in a far higher state of purity than had previously been attained.

Heat-Resisting and Non-Corroding Steels.—Sir Robert Hadfield, Bt., has now published in pamphlet form his lecture before the Institute of Marine Engineers last January on "Progress in the Development and Practical Application of Heat-Resisting and Non-Corroding Steels." A full abstract of the lecture was published in our issue for April 14

Trade Talk.

EDGAR ALLEN & COMPANY, LIMITED, propose installing an Ajax-Wyatt electrically heated crucible steel furnace.

THE GANDY BELT MANUFACTURING COMPANY, LIMITED, Wheatland Works, Seacombe, Cheshire, have decided to rebuild their works on the present site.

AUTOMATIC AND ELECTRIC FURNACES, LIMITED, Elecfurn Works, 173-175, Farringdon Road, London, E.C.1, announce that they have entered into an arrangement with Carlo Brivio, of Via Principe Umberto 25, Milan, for the manufacture and sale of Wild-Barfield electromagnetic furnaces in Italy.

ARRANGEMENTS HAVE BEEN MADE for the annual dinner of the National Federation of Iron and Steel Manufacturers to take place on Thursday, June 16, at the Connaught Rooms, Great Queen Street, W.C.2. The Chancellor of the Exchequer (the Right Hon. Winston Churchill, C.H., M.P.) and the President of the Board of Trade (the Right Hon. Sir Philip Cunliffe Lister, K.B.E., M.C., M.P.) have promised to attend and to speak.

THE SHIPBUILDERS' INVESTMENT COMPANY have purchased all the assets of the Northumberland Shipbuilding Company from the receiver for the prior lien bondholders. These assets consist of the Howden Shipbuilding Yard at Howden-on-Tyne, 24,580 ordinary shares of £10 each, out of 25,000 of the Fairfield Shipbuilding and Engineering Company, Limited, of Govan, practically all of the issued £750,000 5 per cent. preference, 6 per cent. preference, and ordinary shares of William Doxford & Sons, Limited, Sunderland, and 43,200 ordinary shares of £25 each of Workman, Clark & Company, Limited, Belfast.

THE DARLINGTON FORGE, LIMITED, Darlington, have been informed by Dorman, Long & Company, Limited, that they have received a cable to the effect that the Sydney Harbour Bridge main bearing has been completely erected, set, and concreted, and congratulating the Darlington Forge, Limited, on their accurate workmanship. The fourth and final bearing was practically erected in the shops of Darlington Forge, Limited, on Monday. Briefly, each bearing consists of 21 pieces of forged or cast steel, two pieces weighing 32 tons each, six pieces between 26 and 27 tons each, the other 13 castings being somewhat lighter, and the total weight about 300 tons.

DISCUSSING THE POSITION in regard to the recent announcement with reference to the Minerals Separation process for improved tin recovery, an authority says that the actual application of the process seems to be that in dealing with the slime tin, which, as is generally known, is the product of fine crushing, and is therefore the finest and most elusive, it is comparatively easy to obtain a concentrate containing 10 to 15 per cent. black tin. This is not a marketable product, as the smelters require a metallic content of at least 60 per cent. It is therefore during the operation of bringing this slime concentrate up from 10 to 15 per cent. to 60 per cent. that the great loss of tin is incurred, often rendering the operation economically unsound. Here the new process comes in, and its possibilities are evident. It is said to require expert chemical supervision, in which case it may not be of much use to the small producer. The suggestion is made that he might sell his slimes to a central plant.

THE REPORT HAS BEEN ISSUED of the Preliminary Inquiry under the Boiler Explosions Acts into the cause of an explosion from a cast-iron steam pipe at the Kingshill Colliery, Allanton, Lanarkshire. The observations of the engineer surveyor-in-chief to the Board of Trade are to the effect that the report deals with the failure under ordinary working conditions of a very large cast-iron steam pipe, in which, owing to movement of and damage to the core during casting, the thickness of metal varied from about ¾ inch to 1¾ inches, the change of thickness in some parts being very abrupt. The metal at certain points was also spongy, and the pipe appears to have failed initially at one of these thin and spongy places and then to have been shattered to pieces. The case illustrates very clearly the need for the most careful examination of new cast-iron pipes that are to be subjected to high steam pressures and to the great variations of temperature and stress which such pipes have to sustain in service. No pipe in which a serious difference of thickness is found to exist should be used in a high pressure steam pipe range.

Wills.

PRETTY, I., of Wilden, near Stourport, Worcestershire, manager of the Wilden Iron Works	£4,678
HARVEY, F., of Clanmor, Hayle, Cornwall, chairman of Williams, Harvey & Company, Limited	£61,879

Company Meetings.

Industrial Steels, Limited.—References to the serious effect of the mining strike on the steel trade, and to the prospects of a revival of the steel industry, were made at the annual meeting of Industrial Steels, Limited, last week. VISCOUNT FALMOUTH, who presided, said that in the early part of last year trade was about the same as it had been previously. As the first two months passed, things began to look better, and by the end of March they had hoped to be able to start extra furnaces and go ahead. Unfortunately, that hope was not fulfilled. As a result of the coal dispute, their output was very seriously reduced during a great part of the year, and they had no other means of making a livelihood in the company except by the production of steel. The year's operations resulted in a loss, but, under the unique industrial conditions which prevailed, that was not surprising. As a result of expecting a large increase of trade, they had considerably increased their stock of coal, and this turned out to be a very fortunate thing for both themselves and their customers, because they were able to utilise the fuel in order to roll some of their ingots. After using foreign coal, which was very costly, for some time, they had to stop. They started melting again in September. Thanks to their efforts in getting outcrop coal, they were able to keep the loss down to a great deal less than appeared probable at one time. As to the future, they were busy for the first three months of this year in working through their stock of orders, but the situation at present was not so favourable. It was difficult to prophesy. Orders were not as plentiful as they should be, but they hoped that this might be only temporary. He felt that trade must revive anyhow, later on during the year. The shipbuilding industry, which was a large consumer of steel, was stronger. A great many keels had been laid down during the last few months, and, although the demand for steel did not rise immediately, it must come as the year went on.

Vickers, Limited.—Presiding at the sixtieth annual meeting of the shareholders, at the River Don Works, Sheffield, GENERAL SIR HERBERT A. LAWRENCE said that, with regard to armaments, shipbuilding, and heavy engineering—carried on mainly at the works in Sheffield, Barrow, Erith, Dartford and Weybridge—although the lack of armament and shipbuilding orders, as compared with pre-war days, naturally affected the earning capacity of the works, they represented the original business of Vickers, and if reasonable orders were forthcoming, they could still be counted on to earn profits. The rolling stock group was represented by the Metropolitan Carriage, Wagon and Finance Company, and its associated concerns, and during the past year had proved the most successful of the branches from the profit-earning standpoint. Electrical interests were centred mainly in the Metropolitan-Vickers Company, which, despite the industrial conditions of the past year, had maintained its usual dividend. The chairman went on to mention that during 1926 the company sold their interests in Vickers-Petters, Limited, a concern which had not given them any return for some years, and which involved continuous additional finance. They had closed down the British Lighting and Ignition Company, Limited, disposed of the plywood department at Crayford Creek, and sold their interests in Canadian Vickers. In May last they disposed of their shareholding in William Beardmore & Company, Limited, and were not now interested in that business. He also dealt at some length with the proposed reconstruction and subsequent sale of Wolseley Motors, Limited. Referring to a suggestion that Vickers, Limited, might have bought the assets of the last-named company from the receivers at the same price that Mr. Morris paid, he pointed out that in addition to the purchase price of £730,000, it would have been necessary for Vickers to have found at least another £300,000 or £400,000 as working capital, and whereas the purchaser had the necessary sales and manufacturing machinery available, Vickers would have had to create both a new sales and a new manufacturing organisation, and also design a new small car to put on the market with the existing six-cylinder.

New Companies.

Dominion Steel Corporation, Limited, 2, Westgate, Barnsley.—Capital £2,000 in £1 shares. Directors: J. R. O'Connor and A. D. Butterley.

Lander & Larsson, Limited, 164, Edmund Street, Birmingham.—Capital £20,000 in £1 shares, to acquire business of iron and steel and metal merchants, etc., carried on at 164, Edmund Street, Birmingham, as Lander & Larsson.

IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—Both home and export demands in the Cleveland iron market continue slow and unsatisfactory from the makers' point of view, consumers still refraining from buying except for immediate needs, while stocks at furnaces are steadily accumulating in consequence of competition from low-priced Continental producers. The position, it is feared, will become even more difficult, and already there is some rumour of a curtailment of output. At the moment there seems to be no indication of any potential demand that would be made actual by another cut in prices. Quotations remain as follow:—No. 1, 72s. 6d.; No. 3 G.M.B., 70s.; No. 4 foundry, 69s.; No. 4 forge, 68s. 6d. per ton.

In the market for hematite, recent price concessions have given but little stimulus to buying, and quotations show further weakness. East Coast mixed numbers are now down to 79s. per ton, with the No. 1 quality 79s. 6d. per ton. On the North-West Coast Bessemer mixed numbers are quoted at £4 12s. 6d. per ton delivered at Glasgow, £4 15s. per ton delivered at Sheffield, and £4 15s. to £4 18s. 6d. per ton delivered at Birmingham.

LANCASHIRE.—Consumers of foundry pig in this area, having in many cases forward contracts to draw upon, appear indifferent to current offers at lower rates, and business, therefore, is on a restricted scale. With only a quiet demand, Midland makers now quote both Derbyshire and Staffordshire No. 3 foundry at 85s. 6d. per ton, with Scottish brands from 100s. upwards, delivered locally.

Metals.

Copper.—Consumptive demand for base metals in general has as yet hardly fulfilled market expectations, and in the case of standard copper there has been again a relapse in values to the levels obtaining earlier in the month. A moderate amount of home and Continental buying has been noted, the tendency of which was certainly harder, helped by slightly better reports from America, but purchases continue chiefly confined to early requirements, and values have receded.

Official closing prices of standard copper have been as follow:—

Cash: Thursday, £54 8s. 9d. to £54 10s.; Friday, £54 7s. 6d. to £54 8s. 9d.; Monday, £54 6s. 3d. to £54 7s. 6d.; Tuesday, £53 18s. 9d. to £54; Wednesday, £53 16s. 3d. to £53 17s. 6d.

Three Months: Thursday, £55 to £55 1s. 3d.; Friday, £54 18s. 9d. to £55; Monday, £54 17s. 6d. to £55; Tuesday, £54 12s. 6d. to £54 13s. 9d.; Wednesday, £54 8s. 9d. to £54 10s.

Tin.—Movements in standard tin have been irregular, with a tendency mostly to lower levels in values. Home demand has been restricted, and quieter conditions have prevailed in the United States. No fresh feature has presented itself, the market continuing to vacillate between, on the one hand, an admittedly strong statistical position, and, on the other hand, the uncertain industrial outlook, while some apprehension is expressed that supplies may overtake demand during the coming months, which often mark a quiet period in consumptive buying.

Official closing prices of standard tin have been as under:—

Cash: Thursday, £291 10s. to £291 12s. 6d.; Friday, £291 15s. to £291 17s. 6d.; Monday, £295 to £295 5s.; Tuesday, £295 15s. to £296; Wednesday, £296 10s. to £296 12s. 6d.

Three Months: Thursday, £283 10s. to £283 12s. 6d.; Friday, £284 2s. 6d. to £284 5s.; Monday, £286 10s. to £286 15s.; Tuesday, £287 5s. to £287 10s.; Wednesday, £287 12s. 6d. to £287 15s.

Spelter.—Conditions in the market for ordinary spelter may be regarded as fairly satisfactory, values remaining at steady levels, though slightly easing under disappointing American cables. Demand on the part of home consumers has been fairly well sustained, and reports from the Continent are considered satisfactory.

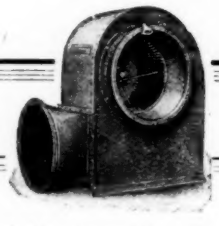
The following are the week's prices:—

Ordinary: Thursday, £29 7s. 6d.; Friday, £29 5s.; Monday, £29 2s. 6d.; Tuesday, £29; Wednesday, £28 11s. 3d.

Lead.—The market for soft foreign pig has developed further weakness, demand on the part of consumers, both at home and abroad, still leaving much to be desired, and supplies being more than ample to meet current requirements.

The week's prices are appended:—

Soft foreign (prompt): Thursday, £24 17s. 6d.; Friday, £24 18s. 9d.; Monday, £24 15s.; Tuesday, £24 12s. 6d.; Wednesday, £24 7s. 6d.



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